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ABSTRACT

Social studies, science and mathematics curriculum improvement projects supported by the National Science Foundation are described in this publication. Description of projects is limited to those having direct relevance to pre-college education and generally to those resulting from grants made through the Course Content Improvement Program of the Division of Pre-College Education in Science. The projects include widely diverse activities: curriculum conferences, the development of new or improved instructional apparatus, the production of complete courses that may include new laboratory experiences and guides, educational films, teachers' guides, in-service materials, and textbooks. The projects are presented within these four categories: Elementary School Projects (K-6); Intermediate School Projects (7-9); Secondary School Projects (10-12); and General Projects (K-12). Included with each project description is a list of available materials and the address(es) for obtaining same. An alphabetical list of project abbreviations and a list of project directors are provided. (PR)

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Course and Curriculum Improvement Projects

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Course and Curriculum Improvement Projects

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- Textbooks
- Laboratory Guides
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Foreword

In very many ways the plans and expectations of Americans, and indeed of people everywhere, depend upon a strong and growing science and technology. The increasing importance of science to our Nation and the world creates pressing educational demands. Literacy in science is becoming essential for all citizens who wish to comprehend the world they live and work in and to participate in the increasing number of local and national decisions, some of gravest import, that require an understanding of science. Further, more and more students must be attracted to scientific and technical pursuits, and these students must be prepared to work with increasingly sophisticated ideas and techniques.

Very practical considerations compel us to give attention to the strengthening of science education. But there is another aspect of the matter, namely, the principle held by those taking part in the reform of science education that more emphasis should be given to disciplined, creative, intellectual activity as a noble enterprise and to intellectual achievement as a worthy end in itself. There is a desire to allow each student to experience some of the excitement, beauty, and intellectual satisfaction that scientific pursuits afford. Similar movements also aimed at giving the student experiences and points of view heretofore largely limited to professionals in a field are beginning to go forward in the humanities and the arts. These experiences, it is hoped, will lead many to enter scholarly professions and others to adopt some of the scholarly and artistic modes of thought in their work and their avocations.

Good teachers and good schools have always worked individually to give students the best educational fare they could. Nowadays, however, the task of bringing the best that has been thought to all students—in ways appropriate to their varied interests, abilities, and future lives—requires new strategy and tactics. We live in an age of explosive growth of knowledge. More scientific and technological discoveries have been made in the past fifteen years than in all previous recorded time. Powerful new insights are being gained into the fundamental structure of major areas of inquiry. Moreover, traditional assumptions about what students at given levels of development can learn are increasingly found to be misleading in many ways. Finally, society can no longer afford to wait for a generation or more for new knowledge to make its gradual way into school and college programs.

In the last few years, mathematicians, scientists, engineers, and educators have taken up these new educational challenges with great vigor. Working together, and aided by increasing public and private support for educational research and development, they have undertaken a number of fresh approaches to the improvement of school instruction in mathematics and science. In colleges and universities, research scientists have been taking an increasing interest in undergraduate instruction. The aim has been to see that instruction presents contemporary knowledge as well as contemporary viewpoints on knowledge established earlier. In many cases it has seemed best to start anew rather than merely to patch up older courses. A distinctive feature of many projects is the effort made to go beyond the presentation of what is known and to provide students with experience in the processes by which new facts, principles, and techniques are developed.

The purpose of the present edition of this booklet, as of the earlier editions, is to provide a readily available guide to curriculum improvement projects supported by the National Science Foundation. Decisions on what to teach remain, in the healthy American tradition, the exclusive responsibility of individual schools and teachers. The National Science Foundation does not recommend the adoption of any specific book, film, piece of apparatus, course, or curriculum. It is hoped, however, that the products of these projects will prove to merit serious consideration by all concerned with education at the pre-college level.

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Introduction

This publication updates and replaces in part NSF 66-22 *Course and Curriculum Improvement Projects*. The principal difference between this and the former publication is that this one contains only descriptions of projects having direct relevance to pre-college education and, for the most part, describes the results of grants made through the Course Content Improvement Program of the Division of Pre-College Education in Science. The Course Content Improvement Program has as its objective the improvement of the substance of courses in mathematics, science, and the social sciences at all pre-college levels. Course improvement activities include widely diverse projects ranging from curriculum conferences through the development, including classroom trial and revision, of new or improved instructional apparatus to the production of complete courses that may include new laboratory experiences, laboratory guides, educational films, and teachers' guides and in-service materials as well as textbooks. Outstanding scientists, social scientists and mathematicians in collaboration with teachers, educators and other specialists take responsibility for preparing new and innovative materials which present modern science in challenging but comprehensible form. Other activities of the Program include support of implementation of newly developed materials and studies on the fundamental aspects of learning.

The project descriptions as furnished by the project directors reflect the state of activities as of December 31, 1969. Where project materials are available commercially, the name and address of the publisher, distributor, or manufacturer is given in the description. This publication, therefore, is also intended to replace NSF 68-24 *Released Textbooks, Films and Other Teaching Materials* insofar as that publication pertains to pre-college material. Requests for further information on commercially available materials should be directed to the source cited. A source of further information concerning the project is also cited in most cases; inquiries should be directed to this source and not to the Foundation. It may be noted, however, that the results of many of the projects have been translated or adapted for use in foreign countries. A list of such materials or other information concerning translation or adaptation for foreign use can be obtained from the Foundation.

I. Elementary School Projects (K-6)

A. MATHEMATICS

For additional projects related to this section see also:

28. "Living Biology" Film Series.
60. Video Tape Project of The Associated Colleges of the Midwest.
62. Teaching Resources Development Program in the Geological Sciences.
63. Improving the Development and Use of Academically-Based Social Science Curricula; K-12.
64. Conference on Social Science in the Schools; A Search for Rationale.
65. School Mathematics Study Group (SMSG).
66. Cambridge Conference on School Mathematics (CCSM).

1. UNIVERSITY OF ILLINOIS ARITHMETIC PROJECT. **David A. Page**, Education Development Center, Inc., 55 Chapel St., Newton, Mass. 02160. (1964-)

Beginning in 1958 with a grant from the Carnegie Corporation of New York, the University of Illinois Arithmetic Project has been inventing and developing topics in mathematics for elementary school children. The project became associated with Education Development Center in 1963 to prepare films and written materials to transmit these ideas to teachers and in 1968 completed its first full-scale package of course materials for in-service and pre-service use.

The basic premise of the project is that elementary school children and their teachers can enjoy pursuing important ideas in mathematics if the ideas are introduced in sequences of related problems that are not too difficult for children to solve. Teachers learn much of the course content through problem sequences that they can later adapt for their classes. From the films they learn mathematics along with the children and see some of the ways the ideas can be introduced. Teachers begin working with the ideas in their own classrooms or practice teaching early in the nineteen-session course.

In in-service use, the course is designed to be conducted by local elementary school personnel, making

maximum use of the interest, enthusiasm, and mathematical background already existing in the school community. If desired, groups of elementary teachers are able to conduct the course for themselves, independently of external supervision.

The course package includes written lessons which teachers do between institute sessions, films showing mathematics being taught to classes of children by a variety of teachers, and many supplementary materials providing further mathematical exposition and suggestions for the classroom. Discussion notes and detailed guides for correcting the written lessons are also included.

About half the course is concerned with functions ("number line jumping rules"). Linear, quadratic, and periodic functions are studied along with successive jumps, distance and direction of jumps, and standstill points.

Other topics include maneuvers on lattices of various kinds; work with artificial operations, focusing on commutativity and associativity; lower brackets (the greatest-in eger function) and the analogous upper brackets; and frame equations, including simultaneous equations.

While arrangements are being made for commercial publication, the complete course is available through EDC. For detailed information on the course, write to Jack Churchill, Associate Director, University of Illinois Arithmetic Project, Education Development Center, Inc., 55 Chapel St., Newton, Mass. 02160.

2. SYRACUSE UNIVERSITY-WEBSTER COLLEGE MADISON MATHEMATICS PROJECT. **Robert B. Davis**, Madison Project, 918 Irving St., Syracuse, N.Y. 13210. (Grantee: Webster College, 470 East Lockwood, St. Louis, Mo. 63119.) (1961-1969)

The Madison Project attempts to intervene in the educational process at the level of the child's actual experiences in school, rather than at the level of textbook writing or at the level of stating curricula. Curriculum is one aspect of school experience, but the fully shaped experience goes beyond curriculum, including actions of teacher and student and interactions between them. To give an example, one can list the concepts of average and interquartile range for a finite set of real numbers as a curriculum entry. A classroom experience related to these concepts might be: Four children independently guess the width of the room, and the average and variance of these four numbers are computed. Then four children measure the room width, using 6-inch rulers, and the average and variance of these four numbers are computed. Finally, four teams of children measure the room width using a high-quality surveyor's tape measure, and the average and variance for these four numbers are computed. The meanings of average, variance, interquartile range, etc., are brought out by discussion, but are not stated expositionally by the teacher.

Intervening at the level of actual school experiences is far more difficult than intervening at the textbook or curriculum level, but the effects may be far more important. In order to propagate classroom experiences on a nationwide basis, the project is preparing in-service teacher-training courses based on films showing actual classroom lessons; these films and accompanying written materials are designed to enable teachers to incorporate Madison Project-like experiences into their own classes. The present emphasis is on grades 1-9, plus kindergarten and nursery school, and the subject emphasis is a combination of arithmetic, axiomatic algebra, coordinate geometry, rudimentary study of functions, logic, limit of a sequence, and certain portions of physics.

Available materials include tape recordings, written material and 16 mm black-and-white sound motion pictures *(First Lesson, Second Lesson, A Lesson with Second Graders, Graphing a Parabola, Guessing Functions, Postman Stories, Circles and Parabolas. Complex Numbers via Matrices, In-Service Course I,* and *In-Service Course II).* Some films are also available as 8 mm cartridges. Closely related materials (not supported by NSF) include: Robert B. Davis, *Discovery in Mathematics* and *Matrices, Logic, and Other Topics,* both available from Addison-Wesley Publishing Co., Inc., Reading, Mass. 01867. For copies of the *Newsletter* and further information, write to the project director.

3. EXPERIMENTAL TEACHING OF MATHEMATICS IN THE ELEMENTARY SCHOOL. **Patrick Suppes**, Institute for Mathematical Studies in the Social Sciences, Stanford University, Stanford, Calif. 94305. (1959-)

The curriculum work at the Institute for Mathematical Studies in the Social Sciences at Stanford in computer-assisted instruction in elementary mathematics has two major phases. One phase is concerned with the development of a drill-and-practice supplementary curriculum for Grades 1 to 6. The material in this curriculum is ungraded from the standpoint of the student. Each student is placed in the structure and moved through the structure according to his individual performance, without reference to the performance

of other students. The curriculum is divided into 15 major concepts and skills, ranging from horizontal addition to the solving of elementary word problems. The student is given a grade placement in each of these 15 skill or concept strands. The supplementary strand curriculum is organized so that on the basis of normative decisions about grade placement, and empirical data concerning error rates and performance times, the criterion for moving from one grade-placement level to another in each strand is set so that the average student should make one year's grade-placement progress in one academic year. These computations may not be exactly correct, but the structure is now organized in such a way that it will be relatively straightforward to make corrections on the basis of data we are currently collecting.

The second curriculum activity, which terminates in August 1970, is a further extension and revision of the tutorial computer-based curriculum in logic and algebra. This curriculum has been extended and revised over a number of years. The current efforts are especially aimed at giving more hints and individual help to students as they need it. The basic curriculum remains organized as follows: the first year introduces the student to sentential logic and reasoning about simple algebraic identities; the second year concentrates on the axioms for an ordered field and elementary theorems that can be proved from these axioms; the third year extends the work done in the second year. The aim of the third year is to cover from an axiomatic standpoint a good part of the algebraic content of a ninth grade algebra course, although the full range of problems and applications of that course is not covered. The tutorial curriculum in logic and algebra has been primarily aimed at bright students in Grades 4 to 8. The important aspect of this course is that the student constructs individual proofs or counterexamples, and these are checked recursively by the computer program. Any valid proof within the rules given to the student is accepted by the program.

Material available: *Individualized Mathematics: Drill and Practice Kits*, L. W. Singer Company, Inc., Westminster, Md. 21157.

Further information is available from the project director.

4. FOUNDATIONS OF MATHEMATICS FOR ELEMENTARY SCHOOL TEACHERS. **E. Glenadine Gibb**, Department of Mathematics, State College of Iowa, Cedar Falls, Iowa 50613. (Present address: Science Education Center, The University of Texas, Austin, Tex. 78712.) (1962-1966)

The purpose of the 12 thirty-minute films and the text prepared to accompany them is to provide an introduction and orientation to a longer and more intensive in-service program that a school system might wish to use to improve the training of elementary school teachers. Also, it is a program that may be carried out with only minimal use of consultants from colleges and universities. This project has been supported by the National Science Foundation and the State College of Iowa.

Preliminary materials (video tapes, kinescopes, and notes) developed in 1962-63 were used on an experimental basis in several schools in Iowa during 1963-64. In 1964-65 revisions were made of the films and notes, and a consultants' guide was prepared. The titles of the films are: *What Is a Number?*, *A System of Numeration*, *Operations on Whole Numbers*, *Techniques of Computation*, *Non-metric Geometry*, *The Fractional Numbers: Addition and Subtraction*, *The Fractional Numbers: Multiplication and Division*, *Measurement*, *The Integers*, *Problem Solving*, *Coordinate Systems*, and *Real Numbers*.

A review of the project has been made by J. Fred Weaver, "Foundations of Mathematics for Elementary Schools," *The Arithmetic Teacher* 10, 359 (1963).

Address inquiries to Raymond Schlicher, Director of Field Services, State College of Iowa, Cedar Falls, Iowa 50613.

5. IMPROVEMENT PROJECT IN MATHEMATICS FOR SELECTED GROUPS. **E. Glenadine Gibb**, Department of Mathematics Education, University of Texas at Austin, Austin, Tex. 78712. (Grantee: Southwest Educational Development Laboratory, 800 Brazos St., Austin, Tex. 78701.) (1968-)

The goal of this project is to develop guidelines and prototype materials for curriculum adaptations and modifications of mathematics programs to meet the needs of economically and culturally different children. These modifications are being designed (1) to provide the target populations with opportunity to be successful in acquiring mathematical understandings and skills; (2) to enhance the development of positive attitudes towards mathematics; (3) to increase student competency in mathematics beyond the limits which present school programs are achieving for the target populations; and (4) to develop teacher education materials for staff development in adapting and modifying mathematics programs.

Preliminary prototype adapted materials have been designed for children who have been placed in Grades

1, 2, 3, 4, 5, 7, and 8. The project has produced and revised four booklets with accompanying teachers' guides for each of the grade levels 2, 4 and 7; preliminary adapted materials in four booklets for each of the Grades 3, 5 and 8; and preliminary adapted materials in three booklets for Grade 1. Presently, the revised materials are being pilot tested in Grades 2, 4 and 7; and the preliminary materials are being pilot tested in Grades 1, 3, 5 and 8. The development of these materials was preceded and paralleled by studies of samples of the target populations for purposes of identifying sociological and psychological mathematics. The sociological and psychological studies are being completed, after which reports will be prepared for dissemination.

Findings from the studies and summative and formative evaluations of adapted and modified prototype mathematics curriculum materials and corresponding teaching strategies are providing the basis for the teacher education program which will include adaptation and modification of mathematics curriculum materials as appropriate. Research and evaluation studies to date indicate priority needs for teacher education and staff development.

Further information may be obtained from the project director.

6. THE MATHEMATICS AIDS PROGRAM. **Alvin N. Feldzamen**, Educational Broadcasting Corp., 304 W. 58th St., New York, N.Y. 10019. (1967-)

The objective of the project is to plan and try out some pilot programs for an experiment in televised in-service elementary school teacher education in mathematics. The programs will be aimed at the general public, but with special emphasis on elementary school teachers as the primary target audience. Specific features will include viewing audience participation, special mailings to teachers in trial viewing localities, support of broadcast and written materials by an individualized telephone answering system, and feedback from selected subpopulations. The project intends to involve university mathematicians and other appropriate scholarly experts in educational television work, much as the early course content improvement projects pioneered the involvement of scientists in curriculum work.

For further information write to Dr. Alvin N. Feldzamen, Encyclopaedia Britannica Educational Corp., 425 North Michigan Ave., Chicago, Ill. 60611.

7. IN-SERVICE FILMS IN MATHEMATICS FOR ELEMENTARY TEACHERS. **Harry D. Ruderman**, Department of Mathematics, Hunter College High School, 930 Lexington Ave., New York, N.Y. 10020. (Grantee: National Council of Teachers of Mathematics, 1201 16th St., N.W., Washington, D.C. 20036.) (1963-1966)

The objective of this project was to produce a series of 16 mm mathematics films (30 minutes each) in color, to be used for the in-service training of elementary teachers embarking on a new program in elementary school mathematics.

The project has produced ten films, each accompanied by text materials and a teachers' manual for the whole series. Another film is in preparation.

The content of the course is the development of the whole number system, the operations in it and their properties, our common decimal system of numeration, and the usual algorithms. This presentation is consistent with the recommendations of the Committee on the Undergraduate Program in Mathematics of the Mathematical Association of America.

The series is intended for use by institutes for elementary school teachers (summer or in-service), and for study groups of elementary school teachers involved in teaching the newer programs. The films are available from Universal Education and Visual Arts, 221 Park Avenue South, New York, N.Y. 10003; a text, *Mathematics for Elementary School Teachers*, is available through the NCTM office.

For further information write to James D. Gates, Executive Secretary, National Council of Teachers of Mathematics, or to the project director.

8. STUDY OF MATHEMATICS ACHIEVEMENT IN GRADES K-3. **E. G. Begle**, School of Education, Cedar Hall, Stanford University, Stanford, Calif. 94305. (1966-)

The objective of this four-year study is to extend the information being gathered and analyzed in the National Longitudinal Study of Mathematical Abilities (NLSMA), now in its fifth year to the lower primary level, and to provide a sound basis of factual knowledge for further reform in mathematics education in the early grades. Approximately 2,000 students will be part of the study. Special tests for measuring mathematics achievement will be developed during the course of the study to evaluate higher cognitive skills usually ignored by standard tests. While the main thrust of the project is the investigation of mathematics achievement in terms of curriculum materials, the study will also be concerned with such variables as socio-economic status and the timing and placement of exposures to mathematical concepts. (See also project No. 65)

B. MATHEMATICS AND SCIENCE

9. MINNESOTA SCHOOL MATHEMATICS AND SCIENCE TEACHING PROJECT (MINNEMAST). **James H. Werntz, Jr.**, Minnesota School Mathematics and Science Center, University of Minnesota, Minneapolis, Minn. 55455. (1961-1970)

The main goal of the MINNEMAST Project is the development of a coordinated curriculum in mathematics and science for the primary grades of the elementary school. The project proceeds on the assumptions that a school curriculum in science and mathematics should be considered a unity, that the instruction in the elementary school years should prepare children in knowledge, skills, and attitudes, and most importantly, that it should develop a cognitive paradigm in children within which they can heuristically organize content and skills acquired from any of a variety of sources.

Twenty-two units of the coordinated math-science materials for kindergarten, first, and second grades have been printed and have undergone tryout during the 1967-68 and 1968-69 school years and are currently in trial classes. Seven additional coordinated math-science units for grade three have been developed and underwent limited trial last year. All the coordinated units produced so far have been based on the separate first trial draft materials in mathematics and in science and have been modified in accordance with the evaluation of their use with children through MINNEMAST trial centers. Most of the evaluation activities are conducted in the nearby Twin Cities Center. Five other MINNEMAST centers, distributed nationally, cooperate further in the controlled evaluation of the materials. The centers are administered through colleges and universities with a major responsibility for pre- and in-service instruction of elementary teachers and as such they serve as foci for concurrent dissemination and for subsequent implementation activities.

In conjunction with the project's concern and efforts to improve the preparation of prospective elementary teachers, the text, *Ideas in Mathematics*, a course written by Professor Avron Douglis of the University of Maryland has been published through W. B. Saunders Co., West Washington Square, Philadelphia, Pa. 19105, to provide a new approach to undergraduate mathematics instruction. Since several MINNEMAST Units involve living things, the project has produced a teacher's resource handbook, *Living Things in Field and Classroom*.

During the period September 1969 to June 1970 the third grade materials received final classroom trial and evaluation in the various centers. In addition, an evaluation of the overall K-3 coordinated materials has been conducted and the project will develop alternative transitions from the MINNEMAST K-3 materials to existing upper-elementary materials.

Further information may be obtained from the project director.

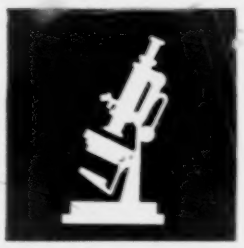
10. UNIVERSITY OF ILLINOIS COMMITTEE ON SCHOOL MATHEMATICS (UICSM): ELEMENTARY SCHOOL MATHEMATICS AND SCIENCE PROJECT. **Max Beberman**, University of Illinois Committee on School Mathematics, 1210 West Springfield, Urbana, Ill. 61801. (1969-)

This project is concerned with the role of mathematics and science in an elementary school program in which the "integrated day" is the major approach. This approach is one in which a class is divided into small groups with each group working on some one aspect of a central theme. Groups work for the entire day and the theme may require one or more weeks of such intensive effort. Most themes have mathematical and scientific aspects, and it is with these aspects that the project is primarily concerned.

The project is also concerned with the interrelations between mathematics and science, the use of laboratory-type and manipulative equipment in the learning of mathematics, the very early introduction of decimal fractions and notation, and the invention of teaching procedures which help develop the ability to reason.

The project staff works in a laboratory school covering grades K-6 and includes mathematics and science educators, experienced elementary school teachers, and mathematicians.

Additional information is available from the project director.



C. SCIENCE

11. AAAS COMMISSION ON SCIENCE EDUCATION. **John R. Mayor**, American Association for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington, D.C. 20005. (1962-)

The AAAS Commission on Science Education, appointed by the Board of Directors of the American Association for the Advancement of Science, has broad concerns for the improvement of science education at all levels of instruction from kindergarten through college, and for the education of science teachers. The Commission is concerned with the teaching of the natural and social sciences, and mathematics, and in its activities interdisciplinary considerations are emphasized. The Commission is also interested in science education through out-of-school activities.

Some of the ways in which the Commission has contributed to the improvement of science education at the pre-college level are:

1. Produced a program in elementary school science, known as *Science–A Process Approach*, for use in kindergarten through grade 6. The distinctive features of *Science–A Process Approach* may be summarized as follows:
   a. Instructional materials are contained in booklets written for, and used by, the teacher. Accompanying kits of materials are designed for use by teachers and children. Except for certain data sheets in the later grades, there are no printed materials addressed to the pupil.
   b. The topics covered in the exercises sample widely from the various fields of science. Mathematics topics are included, to be used when needed as preparation for other science activities.
   c. Each exercise is designed to achieve some clearly stated objectives. These are phrased in terms of the kinds of pupil behavior which can be observed as outcomes of learning upon completion of the exercise.
   d. Methods for evaluating pupils' achievement and progress are in integral part of the instructional program.
2. Maintained a Clearinghouse of Information in cooperation with the University of Maryland Science Teaching Center which has issued annual reports on course content development projects in science and mathematics.
3. Sponsored annual seminars in science for school superintendents in cooperation with the American Association of School Administrators.
4. Prepared a set of recommendations on the preservice education in science of elementary teachers, including guidelines for undergraduate experiences in science and with children and schools, and suggestions of projects for needed research and demonstration. Held four regional conferences to bring the recommendations to the attention of scientists and science educators, and to plan ways in which the guidelines might be used to improve the science education of elementary school teachers.

During 1970 the Commission will give major attention to present and future needs in science education, ways of identifying these needs, methods by which improvements in science education can be brought about, and how government and private foundations might assist. Of special interest will be a study of what schools and colleges can do to contribute to the student's understanding of the relation between science and society–what is now being done, what should be done, and how what should be done can be brought about. Attention will be drawn to interdisciplinary considerations and ways of bringing about better correlation among the natural and social sciences and mathematics in the school curriculum.

Available from the Xerox Corporation, 600 Madison Ave., New York, N.Y. 10022: *Science–A Process Approach*, individual classroom unit for grades K-6 complete for 30 pupils, Parts A, B, C, D, and E; each part includes a Science Materials Kit and set of Teaching Guides. The Teaching Guides may be purchased separately. Hierarchy charts for the basic processes and for the integrated processes are also available.

Available from the AAAS Commission on Science Education, 1515 Massachusetts Ave., N.W., Washington, D.C. 20005: *Science–A Process Approach*, teacher texts, Parts Six and Seven, Fourth Experimental Edition; *Commentary for Teachers*, Third Experi-

mental Edition; *Guide for In-Service Instruction; Response Sheets; Supplement to the Guide for In-Service Instruction; Process Measure for Teachers*, Forms A and B.

Further information is available from the project director.

12. ELEMENTARY SCIENCE STUDY (ESS). **Frank J. Watson**, Education Development Center, Inc., 55 Chapel St., Newton, Mass. 02160. (1962-1970)

With the broad range of the sciences to draw upon and with the conviction that building of a structured curriculum is best considered after a long and varied experience with materials placed in the hands of children in the classrooms, the work of the project has been concentrated on the development of many diverse "units." The diversity is in the choice of topics, in the teaching styles implied in the guides, in the physical materials, and in the age levels for which the materials are suitable.

The program is a highly individualized one in which all children have access to the materials for open ended rather than teacher or textbook directed investigations.

The development of units includes a period of careful classroom trial, observation, criticism, and revision. A mix of university scientists and teachers work together in classrooms to test and revise their ideas before the materials are released for general use in the schools. Careful attention is given to all materials used so that all equipment looks like materials which are normally accessible to children in their own environment and not imposingly "scientific."

ESS materials have been used equally successfully in middle-class suburban and low socio-economic areas, large cities and small towns and a great variety of different situations.

Since the emphasis of the project's work is to encourage children to work individually and independently, to devise experiments, and to direct their questions to the materials, there is very little written material addressed directly to children. Each unit has a teacher's guide, and materials for the children to manipulate; some have worksheets, or photographs and some have films. Several supplementary science readers for enrichment are also available.

ESS units are commercially available from the Webster Division of McGraw-Hill Book Co., Manchester Rd., Manchester, Mo. 63011.

Supplementary films are available from: Webster Division, McGraw-Hill Book Co., Manchester Rd., Manchester, Mo. 63011; The Ealing Corporation, 2225 Massachusetts Ave., Cambridge, Mass. 02140; Macalaster Scientific Company, 186 Third Ave., Waltham, Mass. 02154; Modern Talking Picture Service, Inc., 1212 Avenue of the Americas, New York, N.Y. 10036; Universal Education and Visual Arts, 221 Park Avenue South, New York, N.Y. 10003; Popular Science Publishing Company, A-V Division, Inc., 355 Lexington Ave., New York, N.Y. 10017; and Association Instructional Materials, 600 Madison Ave., New York, N.Y. 10022.

Additional films and further information are available from Education Development Center, Inc.

13. SCIENCE CURRICULUM IMPROVEMENT STUDY (SCIS). **Robert Karplus**, Lawrence Hall of Science, University of California, Berkeley, Calif. 94720. (1959-)

The Science Curriculum Improvement Study is developing ungraded, sequential physical and life science programs for the elementary school–programs which in essence turn the classroom into a laboratory. Each unit of these programs is carefully evaluated by SCIS staff as it progresses from early exploratory stages to the published edition. The units originate as scientists' ideas for investigations that might challenge children and that illustrate key scientific concepts. The ideas are then adapted to fit the elementary school and the resulting units are used by teachers in regular classrooms. Thus they are tested several times in elementary schools before they are published.

Central to these elementary school programs are current ideas of intellectual development. A child's elementary school years are a period of transition as he continues the exploration of the world he began in infancy, builds the abstractions with which he interprets that world, and develops confidence in his own ideas. Extensive laboratory experiences at this time will enable him to relate scientific concepts to the real world in a meaningful way. As he matures, the continual interplay of interpretations and observations will frequently compel him to revise his ideas about his environment.

The teaching strategy is for the children to explore selected science materials. They are encouraged to investigate, to discuss what they observe and to ask questions. The SCIS teacher has two functions: to be an observer who listens to children and notices how well they are progressing in their investigations, and to be a guide who leads the children to see the relationship of their findings to the key concepts of science. As planned, the content will be divided about equally

between life science and physical science. The complete package will consist of 12-14 units, each designed to require study for half the school year.

The following units are available in preliminary edition from Rand McNally & Company, P.O. Box 7600, Chicago, Ill. 60680: *Life Cycles, Populations, Relativity, Systems and Subsystems,* and *Position and Motion.* The following final edition units are available from Rand McNally: *Material Objects, Organisms* and *Interaction.*

The following publications are available from the Science Curriculum Improvement Study, Lawrence Hall of Science, University of California, Berkeley, Calif. 94720: Chester A. Lawson, *So Little Done–So Much To Do,* SCIS (1966; revised 1969); C. Berger and R. Karplus, "Models for Electric and Magnetic Interactions," *Science and Children* 6, 43-49 (1968); and SCIS *Newsletter,* issued quarterly.

For information about subsequent reports write Herbert D. Thier, Science Curriculum Improvement Study.

14. ELEMENTARY SCHOOL SCIENCE PROJECT. **J. Myron Atkin**, Department of Elementary Education, and **Stanley P. Wyatt, Jr.**, Department of Astronomy, University of Illinois, Urbana, Ill. 61801. (1960-1968)

Project activity centered on astronomy. The professional astronomers, science education specialists, and classroom teachers who made up the project staff were guided by two principles: (1) Whatever science is taught to children should be sound, (2) What is taught should reflect the essential structure of the subject. By structure is meant the relatively few, but pervasive, concepts that hold the subject together and help the student make an entity of his own of what otherwise is solely a collection of disparate facts. Astronomy is a prime example of an interdisciplinary field in the physical sciences, and basic astronomical concepts rely heavily on mathematics, physics, and chemistry. Each summer (1961-1966) was devoted to the development of certain major conceptual themes, now reflected in a series of six books for children, grades 5-8, plus accompanying teachers' guides. During the school year following each writing conference, new materials were field tested in over 200 classrooms across the country. Evaluation of project material was obtained from cooperating teachers in writing and through interviews, from project staff who visited classrooms where the books were being tested, and from written tests administered to the children. Subsequent revisions were based on this feedback. Considerable evaluation effort was devoted to higher mental processes, cognitive preference, and attitudinal changes.

The books and their senior authors are: *Charting the Universe,* H. Albers; *The Universe in Motion* and *Gravitation,* S. P. Wyatt, Jr.; *The Message of Starlight,* B. F. Peery; *The Life Story of a Star,* K. Kaufmanis; *Galaxies and the Universe,* G. Reaves.

Pertinent references include: J. M. Atkin, "Teaching Concepts of Modern Astronomy to Elementary School Children," *Science Education* 45, 54-58 (1961), and "The University of Illinois Elementary School Science Project," *Elementary School Science Bulletin* No. 66 (1961); and J. M. Atkin and R. Karplus, "Discovery or Invention?" *Science Teacher* 29 (5), 45 (1962).

For additional information write to Harper and Row, 2500 Crawford Ave., Evanston, Ill. 60201, publishers of the six books. Information about Portuguese editions of Books 1 and 3 is available from Instituto Brasileiro de Educacao, Ciencia e Cultura, UNESCO, Sao Paulo, Brazil. (See also project No. 26)

15. QUANTITATIVE APPROACH IN ELEMENTARY SCHOOL SCIENCE (QAESS). **Clifford E. Swartz**, Department of Physics, State University of New York at Stony Brook, Stony Brook, N.Y. 11790. (1963-1965)

The theme of this project's approach is the use of quantitative and functional relationships in the investigation of natural phenomena. During the summer of 1964, project personnel prepared student work sheets, teachers' guides and teachers' reports in a variety of subjects for each of three age levels. The following criteria were established: (1) the average elementary school teacher should be able to teach the materials with no special training; (2) each phase of the work should revolve around a measurement to be performed by the individual student; (3) the project must not entail large amounts of money or unwieldy blocks of time for students or teachers.

Sixty-seven units were produced and tried in three school districts. The units were distributed from grades 1 through 6 and provided examples of quantitative treatment of all the standard natural science topics.

A complete syllabus of lessons for grades 4, 5 and 6 was written by the project director and has been published by Scott, Foresman and Company, 1900 E. Lake Glenview, Chicago, Ill. 60607.

A paper on the assumptions and guidelines for the project and some sample units may be obtained by writing to the project director.

D. SOCIAL STUDIES

16. SOCIAL STUDIES CURRICULUM PROGRAM (SSCP). **Peter B. Dow**, Education Development Center, Inc., 15 Mifflin Pl., Cambridge, Mass. 02138. (Grantee: Education Development Center, Inc., 55 Chapel St., Newton, Mass 02160.) (1963-)

The units developed by the Social Studies Curriculum Program engage students in fundamental issues of human society and its history, issues that are basic to the social problems of our times. By emphasizing the question rather than the answer, these courses help students perceive knowledge as an unfinished business in which they play a part.

An upper-elementary course entitled *Man: A Course of Study*, is based on three questions framed by Jerome S. Bruner, its principal developer. "What is human 'about human beings? How did they get that way? How can they be made more so?

The first half of the course concentrates on the life cycles and behaviors of salmon, herring gulls, and baboons. These studies lead students to question the significance of generational overlap and parental care, innate and learned behavior, group structure and communication, and their relevance to the varying life styles of animal species, including the human species.

The second half of the course is an intensive study of man in society. As culture-building, ethical creatures, tool-makers and dreamers, all men share a common thread, for it is man's ability to symbolize and his gift of self-awareness that allow him to be a cultural creature. The Netsilik Eskimos of the Canadian Arctic are studied in depth, because their society is small and technologically simple, yet universal in the problems it faces.

Course materials rely heavily on research sources and present subject matter through a variety of media, including films, filmstrips, records, posters and booklets. The course is available for sale to schools; a teacher-training program with seminars and audio-visual materials is part of the course. For further information write: Librarian, Social Studies Curriculum Program, 15 Mifflin Pl., Cambridge, Mass. 02138.

II. Intermediate School Projects (7-9)

A. MATHEMATICS

For additional projects related to this section see also:

16. Social Studies Curriculum Program (SSCP).
27. Biological Sciences Curriculum Study (BSCS).
28. "Living Biology" Film Series.
35. Motion Pictures in Meteorology.
60. Video Tape Project of The Associated Colleges of the Midwest.
61. "Horizons of Science" Films.
62. Teaching Resources Development Program in the Geological Sciences.
63. Improving the Development and Use of Academically-Based Social Science Curricula; K-12.
65. School Mathematics Study Group (SMSG).
66. Cambridge Conference on School Mathematics (CCSM).

17. UNIVERSITY OF ILLINOIS COMMITTEE ON SCHOOL MATHEMATICS (UICSM). **Max Beberman**, University of Illinois Committee on School Mathematics, 1210 West Springfield, Urbana, Ill. 61801. (1962-)

In December 1951 the Colleges of Education, Engineering, and Liberal Arts and Sciences established the University of Illinois Committee on School Mathematics (UICSM) to investigate the content and teaching of college-preparatory mathematics in grades 9-12. Financial support from the Carnegie Corporation of New York made possible the development of a variety of instructional materials and their experimental trial in schools throughout the country. Texts and teachers' guides for grades 9-12 were developed. To enable teachers to help in the experimental trial of materials and teaching approaches, the project staff conducts summer training institutes and has also produced teacher-training films for use in them. (There is a 50-film series for training ninth grade algebra teachers. The films are available from Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036.)

In 1962, with National Science Foundation support, the UICSM began the development of new instructional materials for junior and senior high schools. Materials developed include texts, teachers' guides, and

visual aids intended for use with underachieving students in grades 7 and 8, and texts and teachers' guides for a new two-year geometry sequence for the senior high school. Among the topics included in the grades 7-8 materials are a detailed study of the arithmetic of rational numbers expressed as common fractions, decimal fractions, or percents, and an intuitive study of geometry approached through consideration of translations, rotations, and reflections in the plane. The course is intended for students with records of underachievement in mathematics, especially those whose underachievement may reasonably be ascribed to cultural handicaps. Preliminary versions of the course were tried with students in public schools in Champaign-Urbana, Ill., 1964-65 and in several large metropolitan centers during 1966-67. The texts, *Stretchers and Shrinkers* and *Motion Geometry* have been designed with special attention to the appearance of the pages (four-color printing, cartoon strips, large pictorial displays), and an attempt has been made to minimize the requisite reading skills. The new UICSM materials developed for senior high school constitute a two-year vector geometry course for grades 10 and 11, or 11 and 12. That course introduces translations (vectors) as mappings of Euclidean three-space on itself, many of the "traditional" geometrical theorems, introduction to the study of groups, vector spaces, the concepts of linear dependence and linear independence, the nature of distance functions, and trigonometry. In an attempt to illustrate the nature of deductive systems, postulates for an inner product space of translations are introduced gradually, each one chosen to assign to the space those properties which intuition requires for it to be useful as a model of the three-dimensional world of experience.

UICSM is active in a variety of teacher orientation programs aimed at preparing teachers to use its materials. School systems or teacher-training institutions interested in these activities are invited to write to the project director.

The basic text materials developed in the first project (1951-1962) are now obtainable from D. C. Heath and Company, 285 Columbus Ave., Boston, Mass. 02116. These include *High School Mathematics*, Courses 1, 2, 3, and 4, teachers' editions, and also *Introduction to Algebra*. The UICSM seventh and eighth grade materials are available from Harper and Row Publishers, 2500 Crawford Ave., Evanston, Ill. 60201. Vector geometry materials will be available in 1970 from the Macmillan Company, 866 Third Ave., New York, N.Y. 10022. An information sheet containing the project bibliography, reports of research activities, and reprints of articles describing the activities of the UICSM are available from the project director. (See also project Nos. 18 and 19)

18. UNIVERSITY OF ILLINOIS COMMITTEE ON SCHOOL MATHEMATICS (UICSM): NINTH GRADE MATHEMATICS. **Russell E. Zwoyer**, University of Illinois Committee on School Mathematics, 1210 West Springfield, Urbana, Ill. 61801. (1969- .)

In July 1969 UICSM began the development of an applied ninth grade mathematics course. This project was motivated by a growing awareness among staff members that there is a need for a status course which is an alternative to both the conventional ninth grade algebra courses and the conventional general mathematics courses offered by schools today.

The aim of the project is to develop a course which is readily modifiable to meet the differing needs of a wide range of students—one which will be relevant for students who stop studying mathematics after their first year of high school.

The scope of the course will be appropriate to students of varying interests and talents. It will also be relevant to the other subjects the students take—social studies, general science, shop and vocational courses, commercial courses; further, the exact content of the course will be adjustable to the needs of the class. Toward these ends far more material will be prepared than should be included in a one-year course and instruction will be provided for the teacher on how to choose among the topics to best fit the needs of a given class. Teaching techniques aimed at motivating students who have been negative toward or indifferent to mathematics prior to the freshman year of high school will also be developed.

The course will consist of several units, some of which will develop the foundations necessary for other optional units. In broad terms, these units will fall into three independent categories: Coordinates and Functions, Probability and Statistics, Mensurational Solid Geometry. The first of these will comprise the majority of the course.

The present grant supports the project for two years of developmental work, after which time it is planned that the materials will be offered for commercial publication.

Further information is available from the project director. (See also project Nos. 17 and 19)

19. UNIVERSITY OF ILLINOIS COMMITTEE ON SCHOOL MATHEMATICS (UICSM): FILMS FOR TRAINING NINTH GRADE ALGEBRA TEACHERS. **Max Beberman**, University of Illinois Committee on School Mathematics, 1210 West Springfield, Urbana, Ill. 61801. (1962-)

UICSM, under the direction of Professor Beberman, has prepared a series of 50 films intended to acquaint teachers with the content of modern secondary school algebra courses and to exemplify pedagogical techniques which have proven effective with such content. The films have been produced for flexible use in preservice, in-service, or institute training employing either the whole series or selected sub-series. Extensive written materials accompany the films. The film series is available for purchase or rental from Modern Learning Aids Inc., 1212 Avenue of the Americas, New York, N.Y. 10036, and includes the following sub-series:

1. A series of 14 films which trace the developments of concepts and principles which lead to an understanding of equations. The plan is to use this sub-series for a three-week institute or workshop.
2. A 10-film sub-series on operations with real numbers which would be appropriate for a concentrated two-week workshop or for an in-service seminar meeting once a week.
3. A 16-film sub-series on deductive justifications for algebraic manipulation, developing a topic common to all the new mathematics programs. Such a series would be useful for a one-month institute or for a one-semester pre-service course for teachers.
4. A 10-film sub-series on the topic of inequality relations in elementary algebra.
5. A 10-film sub-series pertaining to the relation of algebra to its applications.
6. A 3-film sub-series on pedagogy.

(See also project Nos. 17 and 18)

B. SCIENCE

20. INTERMEDIATE SCIENCE CURRICULUM STUDY (ISCS). **Ernest Burkman**, Florida State University, Tallahassee, Fla. 32304. (1969-)

An example of a typical major curriculum development effort is the Intermediate Science Curriculum Study, based at Florida State University and jointly funded by the U.S. Office of Education and the National Science Foundation. The long-range goal of the project is to develop and implement for grades seven through nine a coordinated science sequence that is scientifically accurate, consistent with good learning theory, and well adapted to the age level for which it is intended. Experimental laboratory kits, student guide books, self-tests, teachers' manuals, behavioral objectives, and evaluation materials have been developed for each grade.

An exemplary feature of the ISCS materials is the fact that they permit the pace and level of instruction to be adjusted to the interests, ability, and background of the individual student. Built into the materials is the instructional point of view that the student should work mostly independently and at his own pace with the teacher serving primarily in an advisory role—giving clues, answering questions, correcting misconceptions, and extending concepts to new situations.

A comprehensive field test of ISCS materials involving more than 100,000 students in 22 states has been underway since 1966. Feedback from that trial is being used in the development of commercial versions of the program. The commercial version of the grade seven materials will be available to schools in September of 1970. Grades eight and nine will follow at one year intervals.

The content for the seventh grade course is organized around the twin themes of Energy, Its Forms and Characteristics and Measurement and Operational Definition. As the student learns to think in operational terms and becomes aware of what it really means to measure something, he discovers a series of relationships that lead him to the concept of energy and reveal the tremendous power of this important idea.

The organizing themes for grade eight are Matter and Its Composition and Model Building. In this

course, the student finds that, although the basic structure of matter cannot be observed directly, a very useful picture—a model—can be deduced by making a few logical assumptions. He then discovers the model he has developed to be a very useful tool for interpreting physical, chemical, and biological situations, both in the laboratory and in nature.

The ninth grade course is designed to synthesize and extend the investigative experience and knowledge up to that point and to apply them to problems of practical and scientific significance. It is composed of a series of discrete "investigations" each designed to occupy the student for six to eight weeks. The pursuit of any investigation requires the student to operate with reduced guidance and to use his newly acquired tool kit of scientific concepts and investigative skills. Topics for the ninth grade investigations are drawn primarily from the earth and biological sciences.

A fifteen-minute black-and-white 16 mm film illustrates the aims and objectives of ISCS and shows actual classroom situations. A newsletter, brochure, and periodic booklets describe the program and on-going activities. (For loan of film, to be placed on mailing list, or for other information, address inquiries to: Adrian Lovell, Intermediate Science Curriculum Study, 507 South Woodward, Tallahassee, Fla. 32304. For price list of equipment kits, experimental books, and commercial editions as they become available, write to: Product Manager, Intermediate Science Curriculum Study, Silver Burdett Company, Morristown, N.J. 07960.)

Further information is available from the project director.

21. INTRODUCTORY PHYSICAL SCIENCE (IPS). **Uri Haber-Schaim**, Education Development Center, Inc., 55 Chapel St., Newton, Mass. 02160. (1963-1969)

This is a physical science course for use in junior high schools. The major emphasis in the course is the study of matter. Laboratory instructions are incorporated into the body of the text; results are not described. Equipment has been designed so students can perform experiments in ordinary classrooms. Materials are available from the commercial sources listed below:

Educational Book Division, Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632: Textbook, Teachers' Guide, Notebook, Achievement Tests and Laboratory Equipment; Macalaster Scientific Company, Rte. 111 and Everett Turnpike, Nashua, N.H. 03060: Laboratory Equipment; and Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036: Films. (See also project No. 22)

22. PHYSICAL SCIENCE II (PS II). **Uri Haber-Schaim**, Education Development Center, Inc., 55 Chapel St., Newton, Mass. 02160. (1967-)

This course is a continuation of the IPS course and in PS II the themes of the interrelationship of matter and electric charge and the different forms of energy and its conservation are developed. The course is intended primarily for the middle segment of the high school population but can serve as a preparation for more specialized courses in science. The Text and Teachers' Guide are in preliminary form and are available for use by schools with a teacher who has had training at an appropriate institute or workshop. Equipment for the course exists and is available under the same terms as apply to the Text and Teachers' Guide. Two series of achievement tests (corresponding to the A and C series of IPS) are in various stages of preparation.

A brochure, "A Progress Report," is available from the project director. (See also project No. 21)

23. BIOLOGICAL SCIENCES CURRICULUM STUDY (BSCS). **William V. Mayer**, University of Colorado, P.O. Box 930, Boulder, Colo. 80302. (1967-1969)

In 1967 the BSCS began a program for the development of guidelines for a modern instructional program in the life sciences for the middle schools. This program entailed a series of visits to junior high schools in various parts of the United States to summarize the current life science programs in these institutions and to identify participants for a series of six conferences to develop recommendations for developing a new life science program. With the working assumption that the purpose of education is to help the individual attain his highest potential and thereby serve himself and the needs of society in a maximal fashion, the conferences focused on the individual at the chronological age of 12 to 15 years. The proposed life science program was designed to center on and emanate from the individual student in his own environment—his needs, interests and societal responsibilities. The summary statement of the recommendations of the conferences developed as a set of guidelines first published in BSCS *Newsletter* 34. The full program is delineated in BSCS *Special Publication* No. 7, available from the project director. (See also project No. 27)

24. EARTH SCIENCE CURRICULUM PROJECT (ESCP). **William D. Romey**, P.O. Box 1559, Boulder, Colo. 80302. (Grantee: American Geological Institute,

2201 M St., N.W., Washington, D.C. 20037.) (1963-)

In the summer of 1964, 41 earth scientists, educators and teachers prepared preliminary materials for a junior high school earth science course, *Investigating the Earth*. The course materials are interdisciplinary and experience-centered with emphasis on student inquiry. Preliminary materials were tested in 1964-65 by about 7,600 ninth graders in 77 schools. Feedback on effectiveness of materials, obtained through reports from teachers, observations by staff members, and testing of students, was used in revising materials at a second writing conference in the summer of 1965. Revised materials were used by about 35,000 students in 375 schools. Feedback from the second phase of testing served as a basis for final revision in the summer of 1966. During the school year 1966-67, 35,000 students are estimated to have used the 1965 revision, and commercial publication of the 1966 version by the Houghton Mifflin Company, 2 Park St., Boston, Mass. 02107, came in 1967. As of March 1969, about 200,000 copies of *Investigating the Earth* (commercial edition) were in use.

In the commercial edition, laboratory exercises are written directly into the text and require students to spend 50 to 75 percent of their time designing, performing, and interpreting investigations. Most investigations contain few detailed instructions, leaving room for teachers and students to behave creatively.

Support for teachers using *Investigating the Earth* is provided by an extensive teachers' guide and by teacher-training institutes conducted by ESCP staff and consultants. Efforts to improve pre-service and in-service training programs continue.

The project staff are currently conducting research programs to evaluate ESCP materials and determine the characteristics teachers need to use them successfully.

In addition to the text-laboratory manual and teachers' guide, the following supplementary materials have been published or are in preparation:

1. Reference Series, published by Prentice-Hall, Inc., and available from the American Geological Institute.
2. A series of 10 single-topic pamphlets and field study guides for publication in late 1970 or early 1971.
3. Three films, *Toward Inquiry*, *How Solid is Rock?* and *Reflections on Time*, are available from Encyclopaedia Britannica Educational Corp., 425 North Michigan Ave., Chicago, Ill. 60611.
4. A quarterly *Newsletter* keeping interested persons informed of progress and activities. The *Newsletter* includes general articles on earth science education. In addition, a Teacher Information Bulletin is sent monthly to teachers using *Investigating the Earth*.

Further information is available from the project director.

25. SECONDARY SCHOOL SCIENCE PROJECT. **George J. Pallrand**, Science Education Center, Rutgers University, New Brunswick, N.J. 08903. (1967-) (Former grantee: Princeton University, Princeton, N. J. 08540.) (1963-1967)

Time, Space, and Matter . . . investigating the physical world . . . is a science course developed by the Secondary School Science Project for use by students at the junior high school level. The course consists of nine interrelated sequential investigations centered on the basic nature and evolution of the earth-moon-sun system. The development of some awareness of what can be learned about this system provides the basic continuity for the sequence: *Encountering the Physical World, Exploring A Slice of the Earth, From Microcosm to Macrocosm, Levels of Approximation, Dimensions and the Motions of the Earth, The Surface of the Earth, The Grand Canyon of the Colorado, The Surface of the Moon,* and *Worlds in Space.*

Throughout the course great emphasis is placed upon what the student himself is able to do given access to primary sources of information. He is continually engaged in manipulating materials, asking questions, and solving various problems of interest. The student is expected to keep a record of what he has observed and of the interpretations that these observations entitle him to make. As the course sequence develops, he finds that it is necessary to refine what has been learned in earlier investigations in view of newer observations and information. All this is designed to help him reach some understanding of the physical world and at the same time to experience, firsthand, the investigative nature of science. As a result, the teacher is cast in a fundamentally different role in the classroom. He acts as a guide and is an active collaborator with the students in search for understanding.

A highly flexible set of materials has been developed to support the student in his role as an investigator in *Time, Space, and Matter.* Several simple pieces of equipment enable students to pursue individually or in pairs many questions that arise in the course. Student Investigation Books have been developed to accom-

pany each investigation. These books provide students with a number of photographs of various phenomena and thus serve as a primary source of evidence for their investigations. The Science Reading Series is composed of 22 paperback books of essay length on various subjects. Some books acquaint students with the writings of scientists who were concerned with the questions being investigated; others provide background information. All of these materials, including a course conspectus, are now completed and available through the Webster Division, McGraw-Hill Book Company, Manchester Rd., Manchester, Mo. 63011.

III. Secondary School Projects (10-12)

For additional projects related to this section see also:

17. University of Illinois Committee on School Mathematics (UICSM).
21. Introductory Physical Science (IPS).
22. Physical Science II (PS II).
23. Biological Sciences Curriculum Study (BSCS).
24. Earth Science Curriculum Project (ESCP).
25. Secondary School Science Project (SSSP).
60. Video Tape Project of The Associated Colleges of the Midwest.
61. "Horizons of Science" Films.
62. Teaching Resources Development Program in the Geological Sciences.
63. Improving the Development and Use of Academically-Based Social Science Curricula; K-12.
65. School Mathematics Study Group (SMSG).
66. Cambridge Conference on School Mathematics (CCSM).

Within this section attention is called to:

45. Use of Mathematics in Science Teaching.

A. ASTRONOMY

26. ASTRONOMICAL MOTION PICTURES FOR SECONDARY SCHOOLS AND COLLEGES. **H. M. Gurin**, The American Astronomical Society, 211 Fitz-Randolph Rd., Princeton, N.J. 08540. (1964-1968)

Two 30-minute astronomical motion pictures have been produced for showing in secondary schools and colleges. In each, a leading astronomer or astrophysicist describes his research and relates it to the broader field of astronomy. The films are primarily intended to help raise the standards of the teaching of astronomy in secondary schools and colleges, and they will be widely distributed to schools, as well as to educational televi-

sion. The title of the first film is *A Radio View of the Universe* (Morton S. Roberts, National Radio Astronomy Observatory). The second film is entitled *Exploring the Milky Way* (George W. Preston, Lick Observatory). Both films are available from Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036, on a rental or sales basis.

Further information may be obtained from H. M. Gurin, Executive Officer, The American Astronomical Society. (See also project No. 14)

B. BIOLOGY

27. BIOLOGICAL SCIENCES CURRICULUM STUDY (BSCS). **William V. Mayer**, University of Colorado, P.O. Box 930, Boulder, Colo. 80302. (Grantee: American Institute of Biological Sciences, 3900 Wisconsin Ave., N.W., Washington, D.C. 20016 (1959-1962); University of Colorado, Boulder, Colo. 80302.) (1962-1969)

The BSCS was established for the improvement of biological education at all levels. Its initial concentration has been on programs for secondary school biology, including texts, laboratory materials, programmed materials, research problems, films and slides for students of diverse abilities from below average to gifted in grades 10-12, as well as materials for teachers and administrators. The stress is placed upon teaching major principles of biology in depth with special emphasis on investigative laboratory work and the teaching of science as inquiry. BSCS policy is determined by an elected Steering Committee of biologists, educators and administrators, meeting annually or semi-annually, and an Executive Committee meeting as required. The content for each major program is reviewed by a special committee of persons well qualified in the particular field.

Three versions of a modern high school course in biology are now available for use in the tenth grade. Although approximately 70 percent of the content is common to all three versions, each one approaches the study of biology from a distinctive point of view. *Biological Science: Molecules to Man* (Blue Version) uses a molecular-biochemical-evolutionary approach; *High School Biology: BSCS Green Version*, an ecological-evolutionary approach; *Biological Science: An Inquiry Into Life* (Yellow Version), a cellular-biochemical-evolutionary approach. These three courses are equivalent in depth of content and designed for students of average and above-average ability. Each version includes a text, laboratory materials, teachers' manual, quarterly tests and a comprehensive final examination.

BSCS laboratory blocks provide six-week programs of concentrated investigation suitable for regular classes, and cover a wide range of areas, including development, ecology, behavior, genetics, and metabolism. A book describing many items of home-made, relatively inexpensive equipment and simplified laboratory techniques has also been produced.

A special handbook for teachers discusses the aims, philosophy, and methods of the BSCS and also presents a set of *Invitations to Enquiry*, prepared discussions on selected biological problems designed to bring out aspects of scientific methods and philosophy.

For academically unsuccessful students the BSCS has prepared a set of materials under the title of *Biological Science: Patterns and Processes*. These materials have been successful with students who have difficulties with regular classroom materials. This program includes a sequence of varied student materials and a comprehensive teacher's edition.

For very capable students the BSCS has published a series of four volumes containing a total of 160 selected investigations they might wish to undertake.

The Biological Sciences Curriculum Study has also prepared a second course in biology emphasizing experimentation and the processes of science. This volume is a non-repetitive work, depending on the student's prior knowledge of biology but not recapitulating it. It consists of a text and a detailed teacher's edition.

Other aids for students include a series of programmed materials on such topics as population

genetics, DNA, human reproduction, and energy relationships, a series of pamphlets on special topics in biology, a sequence of inquiry slides that can be projected in daylight upon a blackboard and the image marked upon by student and teacher in carrying through the inquiry, and a series of 40 *Single Topic Inquiry Films*, which serve as data sources for investigating a specific biological problem.

For information purposes the BSCS produces a *Newsletter* available free upon request, a Bulletin Series concerned with special aspects of biological education, a Special Publication Series dealing with teacher preparation, teacher training films and an information film circulated upon request to those interested in the programs of the BSCS.

For a current listing of BSCS materials and their sources write directly to the project director. *BSCS International News Notes* provides information on BSCS materials that have been translated into languages other than English.

Further information is available from the project director. (See also project No. 23)

28. "LIVING BIOLOGY" FILM SERIES. **John J. Lee** and **Martin Sacks**, City College of New York, Convent Ave. at 138th St., New York, N.Y. 10031. (1969-) (Former grantee: Yeshiva University, 55 Fifth Ave., New York, N.Y. 10003; former director: Roman Vishniac) (1960-1969)

A series of 16 mm sound-color films has been produced that explores the physiology, diversity, structure, behavior, and interactions of plants and animals in their natural habitats. The intent of the film makers was to depict a candid investigation of the life of these organisms without producing an artificial atmosphere. Because the students see the events happening in native environments, it is as if they were the original investigators; they see the dynamic living processes upon which current interpretation and theory are based. Film titles include: *Microscopic Algae; Life of the Pond* (The Standing Water, Life in the Pond, The World of Many Habitats); *The Living Tide* (The Rocky Shore, The Brim of Sand, The Edge of Sea). A number of film loops and shorter single concept films are in preparation.

Distribution of the films for sale or rental: McGraw-Hill Book Co., 340 West 42nd St., New York, N.Y. 10036; Universal Education and Visual Arts, 221 Park Avenue South, New York, N.Y. 10003. Further information can be obtained from the project director.

29. FILMS ON THE NATURE OF VIRUSES. **Wendell M. Stanley**, Virus Laboratory, University of California, Berkeley Calif. 94720. (1959-1961)

Eight 16 mm, black-and-white, sound films, each 30 minutes, were designed to help acquaint high school and college students and teachers and the general public with recent accomplishments of research in virology and implications for understanding certain fundamental problems in biology, and to broaden general appreciation of the role of research in basic science. They were prepared by the project director and six senior staff members of the Laboratory, aided by E. G. Valens, Jr., and in cooperation with educational television station KQED-TV, San Francisco, W. A. Palmer Films, Inc., and the University's Department of Visual Communications. They have been shown on educational television stations throughout the country. Titles of the films are: *Between the Living and the Non-living, Giant Molecules, The Stuff of Life, Viral Genes, How Viruses Kill, Threads of Life, Killers and Carcinogens*, and *Cancer*.

W. M. Stanley and E. G. Valens, Jr., *Viruses and the Nature of Life* (E. P. Dutton and Company, 201 Park Avenue South, New York, N.Y. 10003, 1961). Based on the television series.

Film rental and purchase, television use: National Educational Television Film Service, Indiana University, Bloomington, Ind. 47405.

30. A SPECIAL ISSUE ON PLANT PATHOLOGY FOR THE AMERICAN BIOLOGY TEACHER. **C. W. Boothroyd**, Department of Plant Pathology, Cornell University, Ithaca, N.Y. 14850. (Grantee: American Phytopathological Society, St. Paul, Minn. 55104.) (1966)

In producing a special issue (August 1966) of the *American Biology Teacher* devoted entirely to the one topic, this project seeks to (1) acquaint biology teachers with the science of plant pathology as a means of expressing many of the concepts of general biology, and (2) offer these teachers some simple, but challenging exercises that can be performed in the classroom, the laboratory, and the field.

Copies of this special issue may be obtained free from the Business Manager, American Phytopathological Society, 1821 University Ave., St. Paul, Minn. 55104.

C. CHEMISTRY

31. CHEMICAL EDUCATION MATERIAL STUDY (CHEM Study). **George C. Pimentel**, Department of Chemistry, University of California, Berkeley, Calif. 94720. (1960-1969) (Former grantee: Ohio State University, Columbus, Ohio 43210.) (1959-1960)

CHEM Study resulted, in large part, from a recommendation made in 1959 by a committee established by the American Chemical Society. This committee, after examining the purposes, content and limitations of then current high school chemistry courses strongly recommended a new program of instruction which would emphasize the experimental approach to chemistry and the critical importance of laboratory work.

The content and philosophy of the new course reflect the cooperative efforts of university scientists, industrial scientists, and experienced high school chemistry teachers. The CHEM Study materials were produced over a three-year period. During this time experimental texts, laboratory manuals and films were utilized by some 200 individual teachers and more than 125,000 students. The results of the feedback, as the materials were used, were incorporated in the final editions of the texts and films.

The course was designed to be useful to the student who was college bound, and also to the student for whom CHEM Study would be a terminal course. Special emphasis was given to the close integration of texts, laboratory manuals and films. Films were produced to accomplish those things which could not be done as well in the classroom by the students or the teachers because of impracticality, danger or expense. Furthermore, some concepts could be demonstrated most effectively through the use of animation, a field in which film is especially effective.

Throughout the course emphasis was placed on principles, the understanding of which would grow out of experiments. History and descriptive chemistry were de-emphasized.

The materials produced by the study consist of a text, laboratory manual, a very detailed teachers' guide (785 pages), two self-instruction programs, *The Slide Rule* and *Exponential Notation*, two series of achievement tests, 26 basic films, 17 teacher training films, a presentation film, and information film and two monographs relating to and supplementing the course.

The written materials have been translated into twelve languages and some or all of the films have been translated into seven languages.

A list of materials and the sources from which they may be obtained follows: W. H. Freeman & Co., 660 Market St., San Francisco, Calif. 94104: *Chemistry—An Experimental Science* (text, laboratory manual, teachers' guide, 2nd ed., 1965); Study Achievement Examinations; Programmed Instruction Pamphlets (*Exponential Notation, The Slide Rule* and *Achievement Tests*, which include two series, 1963-64 and 1964-65). Monographs published by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07631 are: *Man-Made Transuranium Elements* (G. T. Seaborg) and *Why Do Chemical Reactions Occur?* (J. A. Campbell). CHEM Study films are distributed by Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036.

32. CHEMICAL BOND APPROACH PROJECT (CBA). **Laurence E. Strong**, Department of Chemistry, Earlham College, Richmond, Ind. 47374. (1958-1968)

This high school course is presented through a textbook and laboratory guide designed to be used together. These materials were developed and tested over several years (1959-63) in high school classrooms throughout the country. The development in the text proceeds in five parts: The Nature of Chemical Change; Electrical Nature of Chemical Systems; Models as Aids to the Interpretation of Systems; Bonds in Chemical Systems; Order, Disorder, and Change. A systematic attempt is made to distinguish between the data produced by experiment and imaginative ideas used to interpret data. The course emphasizes logical schemes which permit students to investigate and interpret a variety of chemical systems; for instance, the use of a

simplified molecular orbital treatment of molecular structure is designed to help students understand the fundamental basis of current thinking about the electrical nature of matter. The closely related laboratory work develops from early experiments with rather complete directions to experiments late in the course which leave much of the design to students. New types of experiments include the use of the method of continuous variations and simple thermochemical measurements. A major feature of the laboratory work is a scheme of vertical development whereby groups of experiments are designed to fit together in such a way that students develop both technical facility and interpretive skill in moving from simple to fairly complex investigations.

A set of achievement examinations to accompany the course is available. Translations in Spanish, Portuguese, and Japanese of the text materials are in preparation. A number of programmed instruction materials including programs on electrostatics, charge cloud models, and thermochemistry are being developed to accompany parts of the course.

Available from Webster Division, McGraw-Hill Book Company, Manchester Rd., Manchester, Mo. 63011: *Chemical Systems* (Textbook), Teachers' Guide; *Investigating Chemical Systems* (Student Laboratory Guide), Teachers' Guide; Examination Sets; and Answer Sheets for Examinations.

Relevant references: L. E. Strong and M. K. Wilson, "Chemical Bonds: A Central Theme for High School Chemistry," *Journal of Chemical Education* 35, 56 (1958); L. E. Strong, "Facts, Students, Ideas," Ibid. 39, 126 (1962) and "Chemistry as a Science in the High School," *The School Review* 70, 44 (1962); and R. W. Heath and D. W. Stickell, "CHEM and CBA Effects on Achievement in Chemistry," *The Science Teacher* 30, 5 (1963). (See also project No. 33)

33. LABORATORY EXPERIMENTS FOR CHEMISTRY COURSES. **H. A. Neidig**, Department of Chemistry, Lebanon Valley College, Annville, Pa. 17003. (1964-1966)

The first phase of this project consisted of an 8-week summer institute in which thirty-one secondary school chemistry teachers participated during the summer of 1965. The institute program was supervised by a group of secondary school teachers and college professors. During the first part of the institute, the participants conducted six different laboratory investigations using recent developments in laboratory operations. Sufficient data were collected to permit statistical treatment. A number of chemical systems were investigated using several different experimental approaches for the latter part of the institute. Data were obtained that were related to specific concepts of chemical principles. Representative of the type of investigations that were conducted was a study of aqueous solutions of sodium phosphate, of sodium hydrogen phosphate, of sodium dihydrogen phosphate, and of phosphoric acid using potentiometric titrations and thermochemical procedures. The resulting data appear to be useful for relating enthalpy, free energy, and entropy changes and for comparing the nature of the various phosphate species.

The second phase of the project was conducted in cooperation with a number of high schools, colleges, and universities during the 1965-66 academic year. The experiments written on the information obtained during the institute were evaluated on the basis of the results obtained by students in the laboratory.

The third phase of the project involved the publication of those experiments which appeared to be the most useful. The following papers have been published: "An Investigation of the Determination of the Calorimeter Constant," *Current Topics*, Webster Division, McGraw-Hill Book Company, **5**, No. 3, 1966; "Statistical Treatment of Experimental Data," *Chemistry* **40**, 28-32, November 1967 and 40, 28-31, December 1967; and, "The Chemistry of Orthophosphoric Acid and its Sodium Salts," *Journal of Chemical Education* **45**, 57 (1968). Additional papers are being prepared for publication. It is hoped that the investigations described in these papers will serve as source material for individuals who are interested in developing their own experiments. (See also project No. 32)

34. VISUAL AIDS FOR TEACHING CHEMISTRY. **R. T. Sanderson**, Department of Chemistry, Arizona State University, Tempe, Ariz. 85281. (1959-1962)

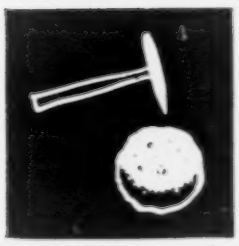
Three 45-minute sound-color, filmed lectures demonstrate the construction and use of new chemistry teaching aids developed previously: (1) *Atomic Models, Valence, and the Periodic Table;* (2) *New Models of Molecules, Ions, and Crystals: Their Construction and General Use in Teaching Chemistry;* and (3) *A Special Set of Models for Introducing Chemistry*. Other work includes (1) further development of the models described in the films, (2) preparation of a laboratory exercise on valence and a lecture aid for teaching atomic structure, and (3) construction of a portable three-dimensional periodic table.

R. T. Sanderson, *Teaching Chemistry with Models* (D. Van Nostrand, Reinhold Company, 450 W. 33rd St., New York, N.Y. 10001, 1962). This book describes in detail the teaching uses of the new atomic and molecular models and tells how to build hundreds of models.

The following papers in the *Journal of Chemical Education* are of either direct or supplementary interest:

"Models for Demonstrating Electronegativity and Partial Charge" **36**, 507 (1959); "Atomic Models in Teaching Chemistry" **37**, 307 (1960); "Valence: A Laboratory Exercise for General Chemistry" **37**, 261 (1960); "An Aid to Teaching Electronic Configurations of Atoms" **37**, 262 (1960); "Principles of Chemical Bonding" **38**, 382 (1961); "Principles of Chemical Reaction" **41**, 13 (1964); "Principles of Hydrogen Chemistry" **41**, 331 (1964); "Principles of Halogen Chemistry" **41**, 361 (1964); "Principles of Oxide Chemistry" **41**, 415 (1964); "A Rational Periodic Table" **41**, 187 (1964).

Film can be rented or purchased from the Extension Division, University of Iowa, Iowa City, Iowa 52240. Suppliers of styrofoam are listed in the book on models. Models patterned after those described in this book are available from Macro Models, P.O. Box 287, South San Francisco, Calif. 91301.



D. EARTH SCIENCES

Meteorology

35. MOTION PICTURES IN METEOROLOGY. **Kenneth C. Spengler**, Executive Director, American Meteorological Society, 45 Beacon St., Boston, Mass. 02108. (1960-)

A series of educational films on various physical and dynamical aspects of the atmospheric sciences is being prepared as supplemental teaching aids and as resource material for earth science courses at the junior and senior high school level and for beginning meteorology courses at the college level. Consisting primarily of 16 mm sound, in either black-and-white or color, as deemed appropriate, the films have been prepared by one or more outstanding scientists in collaboration with various directors and film producers. Although the major effort has been placed on films whose length runs from 20-30 minutes, a few "single concept" cartridged-loop films of 3-5 minutes in length have also been prepared and others are in progress.

Guidance for the program is provided by the Film Panel of the Society, as well as by a specific advisory group of specialists selected for each film. For the benefit of the potential viewer, reviews of the six major completed films have been published in various issues of Vol. 50 (1969) of the *Bulletin of the American Meteorological Society*. All films are available from the following distributors on rental, sale or lease basis: Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036; Universal Education and Visual Arts, 221 Park Avenue South, New York, N.Y. 10003. (See also project No. 36)

36. MONOGRAPH SERIES IN METEOROLOGY. **Kenneth C. Spengler**, Executive Director, American Meteorological Society, 45 Beacon St., Boston, Mass. 02108. (1960-)

In a further effort to provide educational resource material for the science-oriented high school student, for the beginning college student in meteorology, and for the intelligent layman, the Society has been instrumental over the past few years in attracting outstanding scientists to author popular monographs on various physical processes, principles and features of the atmosphere. Published by Doubleday & Company, Inc., Garden City, Long Island, N.Y. 11530, as a part of their Anchor Science Study Series, the volumes are

designed to inform, stimulate curiosity, and attract potential students.

The Society's Board of Editors solicits and reviews manuscripts, and, based on their evaluation, makes recommendations to Doubleday with respect to publication. Although a selected number of hard-cover versions are produced, the normal format is in paperback. Copies may be obtained direct from Doubleday or from most larger bookstores, the paperback varieties ranging in price from $1.00 to $1.50. Reviews of completed volumes are published in the *Bulletin of the American Meteorological Society*. (See also project No. 35)

Oceanography

37. COLUMBIA-LAMONT MARINE SCIENCE FILMS. **Maurice Ewing**, Lamont-Doherty Geological Observatory, Columbia University, Palisades, N.Y. 10964 (1963-1968)

The series of four 16 mm films (sound-color, 25-30 min. each) is designed to bring important recent advances in the study of the maritime portions of the earth into high school and college classrooms and thus into the mainstream of science education. Study guides accompany the films.

Each of the films is focused on a principal investigator who narrates portions of the film. His working methods and problems are shown and described and the principal facts about that particular discipline are communicated.

History Layer by Layer (David B. Ericson, Lamont-Doherty Geological Observatory), shows the process of raising deep sea cores from the floor of the ocean and how laboratory examination of fossil remains in the core reveals climates of the past. For use in earth science, general science or biology courses, with units on earth history, climates of the past, and the Pleistocene era.

Adaptation to a Marine Environment (Malcolm Gordon, University of California, Los Angeles, Calif.), filmed on location in Thailand, describes attempts to find out how an unusual frog native to the mud flats can live alternately in fresh and salt water. The film is intended for use in biology, health, physical science, or general science courses, with units on osmosis, hydrostatic pressure, diffusion, blood plasma, absorption of food, and excretion of waste.

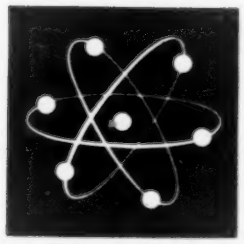
Waves Across the Pacific (Walter Munk, Institute of Geophysics and Planetary Physics, La Jolla, Calif.) shows a study of deep ocean waves from their origin in storms off Antarctica to the breaking waves on an Alaskan beach. Energy spectra, wave amplitude, and wave length are recorded at island stations along the path of the wave train. The film may be used in physical science, general science or mathematics courses with units on wave propagation.

The Earth Beneath the Sea (Maurice Ewing, Lamont-Doherty Geological Observatory), explains how geophysicists study the portion of the earth beneath the ocean waters. Samples are obtained by means of instruments attached to mile-long cables. Where samples cannot be obtained, recording instruments give clues to the nature of the material and the processes going on within it. The film is meant for use in earth science, general science, and physical science courses, with units on earth history, geophysics, and oceanography.

The films were produced under the supervision of the Lamont-Doherty senior staff, with the aid of an advisory committee representing other institutions. Distributor of the films is McGraw-Hill Films, Dept. WP, 330 West 42nd St., New York, N.Y. 10036.

38. OCEANOGRAPHY–EIGHT NARRATED FILMSTRIPS. **Richard C. Vetter**, Committee on Oceanography, National Academy of Sciences-National Research Council, 2101 Constitution Ave., N.W., Washington, D.C. 20418. (1962-1966)

A series of 35 mm color filmstrips with 15 minute recorded narrations. Titles include: *Physical Oceanography*, *Chemical Oceanography*, *Geological Oceanography*, *Biological Oceanography*, *Ocean Engineering*, *Marine Resources*, *Air-Sea Interaction*, and *A Career in Oceanography*. Filmstrips average 70 frames and are accompanied by a recorded narration and booklets containing the narration text, a glossary, a bibliography, and an annotated list of schools, colleges, and universities offering courses in oceanography. Each filmstrip is designed to be used either as part of the complete series, or independently, in classes on biology, physics, chemistry and the earth sciences. The series of 8 filmstrips with records and booklets is available commercially from Encyclopaedia Britannica Educational Corporation, 425 N. Michigan Ave., Chicago, Ill. 60611; Macalaster Scientific Corp., Rte. 111 and Everett Turnpike, Nashua, N.H. 03060; and Quest Films, P.O. Box 859, Champaign, Ill. 61820.



E. INTERDISCIPLINARY

39. BIOMEDICAL INTERDISCIPLINARY CURRICULUM PROJECT. **Jean G. French**, School of Public Health, University of California, Berkeley, Calif. 94720. (1968-)

The purpose of this project is to develop for nationwide distribution an eleventh and twelfth grade biomedical interdisciplinary curriculum which will present fundamental principles in the basic sciences within the framework of health and medically related topics of immediate and current interest to students. Mathematics and communications are presented in conjunction with the life sciences core, and major portions of the curriculum are directly related to daily student experiences in the biomedical laboratory and classroom.

The first year's material will focus on the physical, biological, and psychological needs of the individual; in the second year, the students will complete their study of the individual and will draw on the first year's material to study health problems in the aggregate.

The curriculum will provide the student with a holistic view of man and his environment. The expectation is to present critical and necessary knowledge to each student in an exciting manner, so that he will be interested in directing his attention toward the biomedical field. He will be able to relate the school experience to potential work experience, and, most important, the student should have a better appreciation for and understanding of our complex biosphere.

By its content and approach the program is intended to interest and motivate those students who, though capable, have difficulty handling abstract concepts when unrelated to practical application and vocational opportunities.

Additional information can be obtained from the project director.

40. PORTLAND INTERDISCIPLINARY SCIENCE PROJECT. **Karl Ditmer**, Portland State University, Portland, Oreg. 97207. (1969-)

The Portland Project Committee assembled in 1963 to consider development of interdisciplinary courses for secondary school science students. Their first effort consisted of an integrated chemistry-physics course which was subsequently adopted in approximately 50 schools distributed nationally. The current effort of the committee is development of an integrated biology-chemistry-physics sequence for secondary school use. Foremost among the motivational factors which have led the Committee to development of interdisciplinary courses are that (1) concepts often treated in one science discipline are crucial as background for other sciences, (2) educated men and women must be somewhat literate in several sciences rather than one science, (3) there is obvious redundancy in science content from course to course, (4) today the attack on

research problems (both pure and applied) is interdisciplinary, and (5) a fundamental goal of science is to simplify and search for unity rather than to accept disorder in nature. Therefore, the teaching of science, the Committee believes, should reflect this unity.

The first year of the integrated sequence may be considered both preparatory for what is to come in successive years and may also be viewed as a terminal course for students at the ninth or tenth grade level. Year One is divided into four parts. These are *Perception and Quantification; Heat, Energy and Order; Mice and Men;* and *Environmental Balance.* A sound cross-disciplinary view of biology, chemistry, and physics with unifying themes is presented here. Year Two consists of two parts. These are *Motion and Energy* and *Chemical Reactions.* The main focus in Year Two is to lay the necessary background in chemical and physical phenomena so that students are equipped to proceed into the third year of the course where a substantial amount of biochemical and biophysical concepts are introduced. Year Three consists of four parts. These are *Waves and Particles, The Orbital Atom, Chemistry of Living Matter* and *Energy, Capture and Growth.* The first thrust is to build the orbital model of the atom using as background waves, electromagnetism, and historical models of the atom. With shape, size and energy relationships of molecules established, the DNA molecule is introduced. A culmination of this work comes in the final section where photosynthesis is considered. With this topic much that has gone before is brought into logical focus.

A pilot school study involving fifteen Portland area secondary schools is underway. The third year of the sequence was formulated in the summer of 1969 and is now undergoing testing in eight of these pilot schools.

A collection of papers titled *Excerpts from a Teacher's Guide–Biology, Chemistry, Physics–A Three Year Sequence* is available by writing to Dr. Michael Fiasca, Portland Project Co-Director, General Science Department, Portland State University, Portland, Ore. 97207. First year teacher manuals and student manuals will be available in 1970.

Further information is available from the project director.

F. MATHEMATICS, COMPUTERS

41. SECONDARY SCHOOL MATHEMATICS CURRICULUM IMPROVEMENT STUDY. **Howard F. Fehr**, Box 120, Teachers College, Columbia University, New York, N.Y. 10027. (1969-)

This project is an experiment in curriculum construction and classroom teaching of contemporary mathematics. The curriculum eliminates the traditional separation of the several branches–arithmetic, algebra, geometry, analysis–and unifies the instruction through its fundamental concepts (set, relation, mapping, operation) and structures (group, ring, field, vector space). Efficiency gained by this construction permits the introduction into high school of much mathematics presently taught to undergraduates.

A program based on a similar construction has been developed for junior high school students who are college bound. Based on realized goals, the present study is extending the program through the three-year senior high school. That formal mathematics can be organized in terms of fundamental concepts and structures became well known through the work in foundations at the turn of the century and the Bourbaki analysis begun in the late 1930's. What was not known was how this organization could be presented in teachable form to secondary school students. Guidelines for this became available through the OECD seminars and national committees in other countries.

The program has a helical arrangement with the major structures forming the axis, around which are developed the important realizations and activities within these structures. For algebra, the realizations are the number systems: clock numbers, whole numbers, integers, rationals, reals, complex numbers, and matrices. The activities include variables, expressions, transformations, functions, solutions of sentences,

graphs, problems, proof. For geometry, the realizations are lattice points, transformations, affine space, coordinatized space, vector geometry, and Euclidean space. The activities consist of isometrics and congruence, similitudes and similarity, affine transformations, constructions, proof and axiomatics. Geometry and algebra merge in vector space structure, and all become a basis for the study of analysis.

In Courses I through IV (grades 7-10), the teaching of applications is waived in favor of preparation for future study of applied mathematics. This preparation includes (1) an understanding of real numbers and their use in measure, the geometry of space, and probabilistic thinking; (2) axiomatic mathematical systems as models of physical systems, and (3) facility in using computer and numerical methods as tools. With these conceptual and technical tools available, Courses V and VI will focus on using mathematical methods to solve real problems.

The content and pedagogical features are determined by an eminent group of American and European mathematicians and mathematics educators. The experimental materials are taught in six schools with two specially trained teachers in each class session. Each course undergoes two revisions before release for public use.

Available from Teachers College Press, 1234 Amsterdam Ave., New York, N.Y. 10027: *Unified Modern Mathematics,* Course I, 2 parts and *Teachers' Commentary;* Course II, 2 parts and *Teachers' Commentary;* and Course III, 2 parts.

Available from the project office: *Bulletin of Information* Nos. 3 and 4. The following materials are limited to use by university and supervisory persons interested in the program: Course III, *Teachers' Commentaries* (mimeographed); Course IV, *Experimental Textbook,* 2 parts; and Course IV, *Teachers' Commentaries* (preliminary, mimeographed).

Further information may be obtained from the project director.

42. PREPARATION OF MATERIALS FOR PRE-LIMIT CALCULUS. **Haim Reingold**, Department of Mathematics, Illinois Institute of Technology, Chicago, Ill. 60616. (1965-)

The new approach to the teaching of calculus based on the earlier work of Dr. Karl Menger will be further developed. In that work, graphic and numerical methods are used to initiate the beginner into the understanding of the concepts of area and slope and their reciprocity. The limit concept is introduced after the student has gained a full understanding of the essence of calculus by elementary means. Applications, based on careful distinctions between the ideas of extramathematical fluents ("variable quantities") and mathematical variables, follow articulately formulated rules. Materials produced in the further development of this approach will pertain to the theory of maxima and minima, rate problems, and applications of calculus to geometric questions. They will include problems and exercises comprehensible and interesting to the beginner about extrema and related rates of change as well as tangents, normals, and curvature of curves.

The material to be developed will be tried out first with high school teachers and then, through them as well as directly, with high school students. The resulting material will be made available in manuscript form to interested mathematicians, mathematics educators, and schools.

Further information is available from the project director.

43. HIGH SCHOOL COURSE IN MODERN COORDINATE GEOMETRY. **Robert A. Rosenbaum**, Wesleyan University, Middletown, Conn. 06457. (1964-1967)

A textbook, with an accompanying teacher's commentary, for a tenth year geometry course has been prepared, based on *Modern Coordinate Geometry* (experimental edition, School Mathematics Study Group, 1961). The distinctive feature of the text is the development of affine geometry before Euclidean. Coordinates are used at the outset in a natural way, yielding a body of knowledge unlike that of the traditional high school course but very much like the kind of geometry actually used in subsequent scientific situations.

The text materials were tested in thirty-five classes during 1964-65 and were revised in the light of this experience. Further trials during 1965-66 resulted in a final version which has been published, along with a Teacher's Commentary, by Houghton Mifflin Co., 2 Park St., Boston, Mass. 02116, under the title *Modern Coordinate Geometry*.

Further information is available from the project coordinator, Harry Sitomer.

44. PROGRAMED CORRESPONDENCE COURSES IN ALGEBRA AND GEOMETRY TRAINING OF SECONDARY SCHOOL MATHEMATICS TEACHERS. **Wells Hively II**, Department of Educational Psychology, University of Minnesota, Minneapolis,

Minn. 55455. (Grantee: Minnesota Academy of Science, 3100 38th Avenue South, Minneapolis, Minn. 55406.) (1963-1966)

Two separate courses have been developed, [illegible] in algebra and one in geometry. These are intended to provide the foundations needed to teach any of the newer secondary school curricula. The courses are programed for self-instruction and designed to be entirely self-contained. Each is approximately equivalent to a three-quarter hour course (about 100 hours of work). The algebra course is now published by Addison-Wesley. The geometry course is being brought to completion by the senior author.

A Programed Course in Algebra, Ancel C. Mewborn, University of North Carolina, senior author. Addison-Wesley Publishing Company, Jacobway, Reading, Mass. 01867.

A Programed Course in Geometry for Teachers, Murray Klamkin, Ford Scientific Laboratories, senior author. Experimental edition, not yet generally available.

Further information can be obtained from the Minnesota Academy of Science.

45. USES OF MATHEMATICS IN SCIENCE TEACHING. **J. A. Easley, Jr.**, Department of Elementary Education, University of Illinois, Urbana, Ill. 61801. (1967-1969)

The project has studied ways of improving science teaching at secondary school levels through more appropriate uses of elementary mathematics and has developed sample articles on the uses of mathematics for science teachers. Working with experienced and beginning science teachers at the University of Illinois Laboratory High School, the project has explored a fair sample of mathematical techniques in a variety of high school science courses. A number of points at which mathematics can be used more appropriately and more effectively have been identified, and new or improved mathematical treatments of scientific topics have been explored. It has been found that what appears to be an unfamiliarity with standard mathematical operations is often a confusion about a scientific concept or the relation between science and mathematics. Misunderstanding of this sort is much more common than most science teachers expect, perhaps because children from the age of 8 or 10 are forming theories about the world of their experience. Some of the articles that have been prepared deal with techniques for understanding the conceptual approaches and difficulties children have in quantitative thinking.

The articles developed were conceived as possible entries for a handbook for science teachers. Several avenues of publication are being explored for the 13 articles in hand in hopes that more will be contributed by other groups and authors. It is hoped that wide dissemination of this kind of material will help teachers resolve existing difficulties in relating mathematical techniques and concepts in science courses to the mathematics background of their students.

Further information may be obtained from the project director.

46. DEMONSTRATION OR EXPERIMENTATION IN COMPUTER TRAINING AND USE IN SECONDARY SCHOOLS. **Thomas E. Kurtz**, Kiewit Computation Center, Dartmouth College, Hanover, N.H. 03755. (1967-)

This project is examining how a wide variety of secondary public and private schools can make use of computing in their regular classes.

Significant classroom uses have appeared in mathematics (7-12) and the sciences (8-12). Special projects in the social sciences have been produced by students. Occasional uses have occurred in English, language, and business classes.

A large number of preliminary drafts of teaching units prepared by teachers are now available. These "Topic Outlines" in addition to discussing *ad hoc* uses of computing in various subjects also present several different schemes for introducing computer programming to students.

In addition to the work done within each school, the college has been concerned with the general problem of how a university computing center branches out to become a regional computing center for secondary schools and colleges. Some comments on this problem are to be found in the interim report listed below.

By the end of the current school year, the project hopes to have refined and published several major course outlines detailing where and how a time-shared computer can be well used in regular secondary school classes.

Publications:

a. Dartmouth Publications, Dartmouth College, Hanover, N.H. 03755: BASIC Manual, 4th ed. (1967), and BASIC Manual, 5th ed. (1970).

b. John Wiley & Sons, Inc., 605 Third Ave., New York, N.Y. 10016: BASIC Programming (Kemeny, Kurtz) (1967).
c. Kiewit Computation Center, Dartmouth College, Hanover, N.H. 03755: Interim Report (J. Nevison) (1968); Interim Report II (J. Daver) (1969); High School BASIC (K. Weissman) (1969) "Topic Outlines" and Monthly Bulletin for Secondary Schools.

Further information is available from the project director.

47. INEXPENSIVE DIGITAL COMPUTERS. **Allen L. Fulmer**, Department of Science and Mathematics, Oregon College of Education, Monmouth, Oreg. 97361. (1960-1963)

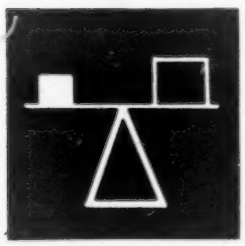
SPEDTAC (Stored Program Educational Digital Transistorized Automatic Computer) is a serial, single address, fixed point, binary-type internally stored program digital computer designed specifically as a classroom and laboratory tool to aid in teaching mathematics and engineering courses. The computer features a non-volatile magnetic disc memory with a capacity of 256 thirteen-bit words, and an average access time of 8.3 msec. A modern teletype printer is utilized for input-output and other types of input-output equipment may also be added.

Further information, including a description of closely related projects (a new and improved Educational Digital Computer, high school pilot programs in computer education, suggested high school course outlines), and sources of commercially available versions of these computers may be obtained from the project director.

48. EDUCATIONAL COMPUTER KIT. **Arnold H. Koschmann**, Department of Electrical Engineering, University of New Mexico, Albuquerque, N. Mex. 87106. (1959-1963)

The University of New Mexico Educational Computer is a digital computer with an internally stored program; it includes the basic features of modern high-speed digital computers. The memory has a capacity of 384 words consisting of 15 binary digits plus sign bit. Operation is in the binary number system, with provision for octal input and output. The major purpose of the machine is to serve as a vehicle for teaching certain topics in mathematics and physics, as well as for teaching the principles of modern computer operation and programming. Because of its slow speed, the computer is well adapted to educational use but is not well suited to lengthy computation.

Further information is available from the project director.



G. PHYSICS, PHYSICAL SCIENCE

49. THE PROJECT PHYSICS COURSE (PPC). **Gerald Holton**, Department of Physics; **Fletcher G. Watson** and **F. James Rutherford**, Graduate School of Education, Harvard University, Cambridge, Mass. 02138. (1965-1969)

Based on the encouraging results of a two-year, small-scale feasibility study underwritten by a grant from the Carnegie Corporation, the project Physics Course was initiated in 1964-65, supported by funds from the Carnegie Corporation, the Sloan Foundation, and the U.S. Office of Education. As the project moved into its second year, it also began to receive support from NSF. The purpose of PPC has been to create a physics course that would be appealing and instructive to a wide variety of students—including those already intent on scientific careers, those who may not go on to college at all, and those who in college will concentrate on the humanities or the social studies. For the last group in particular, it has been necessary to show that physics is neither an isolated and bloodless body of facts and theories with merely vocational usefulness, nor a glorious entertainment restricted to an elite of specialists. Rather, it has been the

intent to present physics as a beautifully articulated, yet always unfinished creation of the forefront of human ingenuity. Thus, while the new course, now being introduced in many high schools and some junior colleges in the U.S.A. and abroad, is centered on a solid introduction to physics, including some of its recent developments, it has specific features to distinguish it from most existing physics courses. For example, as the occasion arises, the text, or assignments in a supplementary reader, stress the humanistic background of the sciences: how modern physical ideas have developed, and who the men and women were who made key contributions; the effect which physics has had on other sciences, especially chemistry and astronomy; the fact that the progress in physics contributes to contemporary technology and in turn is stimulated by it; and the social consequences of scientific advance. The project has developed not only a text, but the necessary array of instructional materials: laboratory apparatus, films, film loops, programed instruction, special readings, transparencies, examinations, teachers' guides, etc. A detailed evaluation of the impact of the course on students has been carried out.

Newsletters describing the project are available. These and a bibliography of published evaluations and research reports can be obtained by writing to the Executive Director, F. James Rutherford, The Project Physics Course, 8 Prescott St., Cambridge, Mass. 02138. All components of the PPC (texts, films, apparatus, etc.) are obtainable through Holt, Rinehart & Winston, Inc., 387 Madison Ave., New York, N.Y. 10017. (See also project No. 50)

50. COMPUTER-BASED SELF-INSTRUCTIONAL COURSE FOR SUPPLEMENTARY TRAINING OF SECONDARY SCHOOL TEACHERS OF PHYSICS. **Arthur H. Rosenfeld** and **Noah Sherman**, Lawrence Hall of Science, University of California, Berkeley, Calif. 94720. (1969-)

The purpose of this project is to produce some prototype programs for a computer-based self-instructional course for the project physics course which can be used in training high school science teachers. The project will involve physicists and science educators who have been concerned for some time with problems of teacher education and also computer scientists who will collaborate in the production of the pilot programs. The motivation for the development of the prototype programs is the potential of such materials as a resource in science education, particularly in the training of school teachers who, through self-instruction, could further the implementation of curriculum innovations. The immediate objectives are the production of about 20 hours of material on suitable fundamental subjects selected from each of the basic units of the Project Physics curriculum. The programs will be primarily in the conversational mode and will include attempts to incorporate computing, problem solving, modeling, and laboratory simulation. As the programs reach trial stages, small numbers of high school teachers in the San Francisco Bay area will be invited to use them and provide a few exchanges of feedback, revision, and re-trial.

The basic hypothesis underlying the project is that computer-based self-instruction is particularly valid in the training of school teachers and the implementation of new course improvements. Self-instructional materials prepared with the kind of range and flexibility made possible by the computer offer the science teacher individual continuing support in his efforts to learn and implement curriculum innovations. This mode of instruction may be more effective than conventional teacher institutes and thereby justify the effort and cost required to develop it. Thus, although computer-based self-instruction may not yet be economical for high school students, its value in teacher training is multiplied by the number of students who ultimately benefit from the better-trained teachers. One important aspect of the project, therefore, is an attempt to assess the effectiveness of such an approach to teacher training and to develop information on cost in time and money required to produce computer-based self-instructional materials at the required level of sophistication. Other aspects to be investigated are the attitudes of teachers in particular and of users in general toward such materials, and the ability of user-teachers to produce their own revisions and extensions for people like themselves and for their students.

Further information can be obtained from the project directors. (See also project No. 49)

51. PHYSICAL SCIENCE STUDY COMMITTEE (PSSC). **Uri Haber-Schaim**, Education Department Center, Inc., 55 Chapel St., Newton, Mass. 02160. (1959-1968) (Former grantee: Massachusetts Institute of Technology, Cambridge, Mass. 02139.) (1956-1959)

The PSSC physics program has developed a textbook; a laboratory guide with new experiments; simplified, low-cost apparatus in kit form; 54 films which set the tone and standards for the course; achievement

tests; an extensive library of paperbound books written by distinguished authors on topics of science; and teachers' guides which provide background material and make concrete suggestions for class and laboratory activities. All course materials are available from the commercial sources listed below. The PSSC course consists of four closely interrelated parts. The first is a general introduction to the fundamental physical notions of time, space and matter. This is followed by a study of light, both optics and waves; a study of motion from a dynamical point of view; and a study of electricity and the physics of the atom. The course concentrates on fewer facts than are usually included in an elementary physics course. Considerable time is spent on the stories running through physics which tie together the facts with explanations. The laboratory is an important tool in learning the ideas and is on an equal level with the textbook, class discussions, and films as a means of learning and teaching.

The text, *Physics*, laboratory guide, and teachers' guide, published in 1960 have been revised and published in 1965 in a new edition. Four chapters of the text have been extensively reorganized and rewritten, five chapters have been shortened and five have been reorganized or reworded. Homework problems have been thoroughly revised for each chapter on the basis of teacher feedback information. Also, a new type of short problem has been included in the new edition in direct response to teacher feedback. Each of these new problems refers to a particular section of the chapter and uses material only from that section. The problems are identified by a section reference number, and answers are given in the back of the book. The new laboratory guide contains several new experiments. Several old experiments have been reduced to the status of "necessary demonstrations." The teachers' guide has been revised to bring it into conformity with the revised text and laboratory guide.

Further information is available from Education Development Center, Inc.

Materials: the textbook *Physics*, laboratory guide, and teachers' guide: D. C. Heath & Co., 125 Spring St., Lexington, Mass. 02173

Apparatus kits: available from several supply companies.

Achievement tests (3 batteries: the original battery, an alternate battery, and a scrambled version of the original battery): Cooperative Test Division, Educational Testing Service, Princeton, N.J. 08540.

PSSC films (each 16 mm, sound and black-and-white except as noted), rented and sold by Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036. (See also project No. 52)

52. PHYSICAL SCIENCE STUDY COMMITTEE—ADVANCED TOPICS SUPPLEMENT. **Uri Haber-Schaim**, Education Development Center, Inc., 55 Chapel St., Newton, Mass. 02160. (1960-1969)

This course is intended for use interspersed in the Physical Science Study Committee (PSSC) course, as additional material for a high school course following PSSC, or as part of an introductory college course. Materials are available from the commercial sources listed below: D. C. Heath & Company, 125 Spring St., Lexington, Mass. 02173: Textbook and Laboratory Guide combined, Teachers' Guide; Macalaster Scientific Company, Rte. 111 and Everett Turnpike, Nashua, N. H. 03060: Laboratory Equipment; Science Electronics Division General Electronics Labs, 1085 Commonwealth Ave., Boston, Mass. 02215: Laboratory Equipment; Educational Testing Service, Princeton, N.J. 08540: Achievement Tests; and Modern Learning Aids, 1212 Avenue of the Americas, New York, N.Y. 10036: Films. (See also project No. 51)

H. SOCIAL SCIENCES

53. ANTHROPOLOGY CURRICULUM STUDY PROJECT (ACSP). **Malcolm Collier**, Anthropology Curriculum Study Project, 5632 Kimbark Ave., Chicago, Ill. 60637. (Grantee: American Anthropological Association, Washington, D.C. 20009) (1962-)

ACSP was organized in 1962 by the American Anthropological Association in response to expressions of interest in the potential contribution of anthropology to high school education. The principal tasks of ACSP have been definition of that role and development of materials to fulfill it. Anthropology has had no place in the conventional curriculum but ACSP materials may well provide the ideas and materials school people have been seeking as a basis for modernizing the social studies curriculum.

ACSP draws on the processes and concepts of the social sciences to provide students with tools to sharpen analysis, enrich interpretation and increase insight into social data. The project chose to develop materials to reach the largest number of students rather than only advanced students or elective courses; and to promote student involvement and to develop a variety of abilities: observation, speculation, perception of implications in data. Student materials include readings, sound filmstrips, casts of stone tools and figurines, overhead transparencies and evidence cards.

In developing the experimental courses, the staff consulted extensively with anthropologists, school people, and the AAA Advisory Committee. The final course, *Patterns in Human History*, which uses but is not limited to ideas and materials from the experimental courses, is designed to be the first semester of a ninth or tenth grade world history or world cultures program. Anticipated publication date is 1970-71. The central idea of the course is culture: what did culture have to do with the evolutionary process that produced man as we know him today? with humanness? with human nature? what have been the broad patterns in the evolution of culture? how have differences in cultural capacities affected the relations between societies? what kinds of cultural change are involved when a society attempts to "modernize"?

Anthropology is new to most high school teachers so ACSP materials include extensive background for the teacher. Because *Patterns* is more selective than the usual college course, more involving of student participation, and specifically relevant to students' experience of social data, teachers may be at an advantage in not having taken college courses lacking these goals.

Early in 1969 a program of research and implementation in the use of ACSP materials was initiated to provide data to facilitate optimal use of ACSP materials and to assess the impact of these materials on: (1) students' intellectual development, and (2) the school as a social system.

Materials available on request from ACSP office in Chicago: *Newsletter*, description of course, *Patterns in Human History* (early '71), *Two Dozen Anthropology Books*, an annotated bibliography.

ACSP classroom films: *Day One* and *Inference from Archeological Evidence* are 16 mm black-and-white, each about 20 minutes long, each showing a class using the first lesson of an experimental course. Rental fees 1-2 days: $5 plus return postage and insurance; one week: $10 plus return postage and insurance. Orders and requests for further information from ACSP office.

Available from the Macmillan Company, 866 Third Ave., New York, N.Y. 10022: *The Great Tree and the Longhouse: Culture of the Iroquois* by Hazel W. Hertzberg. Teacher's Manual by Hazel W. Hertzberg. *Kiowa Years: Study in Culture Impact and Profile of a People* by Alice Marriott. Teacher's Manual by Rachel Reese Sady. *An Annotated Bibliography of Anthropological Materials for High School Use* by James J. Gallagher.

Three-week course, *History as Culture Change: An Overview.* (See also project No. 54)

54. ANTHROPOLOGY CASE MATERIALS PROJECT. **Robert G. Hanvey**, Indiana University Foundation, Bloomington, Ind. 47401. (1969-)

This project, a supplement to but not a continuation of the Anthropology Curriculum Study Project (ACSP) sponsored by the American Anthropological

Association, will undertake the generation of an experimental, innovative model for change in curriculum improvement with materials that will supplement those developed by ACSP. The project intends to develop two "unfinished" units for the high school level on the topics of (1) Biological and Social Differentiation of Man, and (2) Science, Technology and Change. Each unit will occupy from two to four weeks of class time, and the units will be cross-cultural and comparative. The distinctive feature of this project, the development of the units as unfinished packages, is intended to encourage teachers to concern themselves with the substantive ideas of their courses and to facilitate adaptation of curriculum materials to local and/or, changing conditions. Student materials will be made up of "elements" subject to a variety of logical organizations that can be intermixed with locally created elements. The project will provide study and discussion materials to assist social studies teachers in completing the units. These materials will include readings, recorded interviews with scholars, and documentation of contemporary incidents related to the topics under consideration. The effectiveness of the materials in the classroom and the overall effect of this innovation on the school and community will be assessed by teachers with procedures and instruments provided by the project. (See also project No. 53)

55. FILM SERIES: "SPADEWORK FOR HISTORY." **E. Mott Davis**, Department of Anthropology, University of Texas, Austin, Tex. 78712. (1961-1964)

The basic purpose of the series is to present one type of scientific activity, archaeological research in the United States, as it actually takes place—as scholarship, as practical engineering and management in field and laboratory, and in general as one of the many human activities that are integral parts of modern civilization. The aim is to challenge the student who might undertake scientific work—the kind who is both practical-minded and intellectually oriented. The focus of the series is on reservoir salvage archaeology, which provides a forceful example of the close interrelationship between non-scientific matters and scientific research. The first film tells the story for the country as a whole. Each of the other five includes a brief review of the prehistory of one part of the country, and tells how archaeologists go about their work in that area. The six films (16 mm, color-sound, 29 min.) can be viewed independently, but are more effective when viewed in sequence. Titles are: *Salvaging American Prehistory, The Woodlands, The Plains, The Desert, Plateau and Pacific, Salvaging Texas Prehistory.*

Film rentals: Film Booking Office, Visual Instruction Bureau, Division of Extension, University of Texas, Austin, Tex. 78712. Film sales: Radio/Television, University of Texas.

56. PRIMATE BEHAVIOR UNIT. **Sherwood L. Washburn** and **Phyllis Dohlinow**, Department of Anthropology, University of California, Berkeley, Calif. 94720. (1967-)

A study of the behavior of non-human primates offers a promising approach to understanding human behavior, perspective on the relationships between biology and the social sciences, and insight into the relationship of experimental to descriptive science. This project is developing a unit on primate behavior which will be useful as enrichment material for high school social studies courses. The primate unit is intended to convey an understanding of behavior as an adaptive phenomenon. It will include descriptions of the daily lives of several non-human primates, a film on primates derived from existing footage, and textual treatment of topics such as "communication," "peer group relationships," and "territorial appropriation."

Further information is available from the project director.

57. HIGH SCHOOL GEOGRAPHY PROJECT. **Dana G. Kurfman**, P.O. Box 1095, 2985 East Aurora, Boulder, Colo. 80302. (Grantee: Association of American Geographers, Washington, D.C. 20036) (1964-)

The project's major goal has been the development of a one-year geography course for students in grades nine through twelve. The completed course, *Geography in an Urban Age*, is being published by the Macmillan Company, 866 Third Ave., New York, N.Y. 10022, during the 1969-70 school year. Units are: *Geography of Cities, Manufacturing and Agriculture, Cultural Geography, Political Geography, Habitat and Resources*, and *Japan*. Units are printed separately so materials can be selected to suit the needs of individual schools. Activities in each unit emphasize small group work, inquiry, and decisionmaking as students seek to determine why cities, industries, and institutions are located where they are. Each unit also includes various types of audio-visual materials and most incorporate at least one educational game.

The High School Geography Project was initiated in September 1961, with a grant from the Fund for the Advancement of Education. Conferences among leading geographers and teachers brought out concepts, understandings, skills and attitudes which they believed should be developed at the high school level. The units were prepared by professional geographers in universities, in consultation with public school teachers and educational psychologists. The course has undergone extensive school trials under the direction of the project's evaluation team in consultation with the Educational Testing Service. A minimum of geographic background is necessary to teach the course materials successfully. A film entitled *High School Geography: New Insights* has been developed to help teachers use the units effectively.

Current work is concentrated on the development of teacher education materials for use in college instructional methods classes and school in-service programs. These materials will be designed for general social studies teachers as well as geography teachers. Each set of teacher education materials provides participatory experiences for the teachers and undergraduates involved. Included also are suggestions for inquiry and decisionmaking. Methods of evaluating these learning outcomes are then suggested. Materials are designed for fifteen hours of instruction. They will be self-contained and ready for use by college methods teachers and directors of in-service programs.

College social studies and geography methods instructors as well as directors of social studies in-service programs will try out the teacher education materials. A teacher education sampler is available.

Publications available from project office: *Newsletter;* a brochure, *HSGP;* teacher education sampler at cost.

Publications available from the Macmillan Company, 866 Third Ave., New York, N.Y. 10022: *Geography in an Urban Age;* a film, *High School Geography: New Insights.*

58. SOCIOLOGICAL RESOURCES FOR THE SOCIAL STUDIES (SRSS). **Robert C. Angell**, 503 First National Building, Ann Arbor, Mich. 48108. (Grantee: American Sociological Association, 1001 Connecticut Ave., N.W., Washington, D.C. 20036.) (1964-)

In developing a large body of teaching materials for senior high schools, the project has two main objectives: to present substantive sociological content of high quality and to emphasize the process of inquiry.

The published work will be of three kinds: (1) a large number of short units called "episodes" suitable for use in a wide variety of senior high school social studies courses, (2) a one-semester sociology course, and (3) a series of six paperback books, each consisting of research-based readings on a broad sociological topic. Allyn and Bacon, Inc., 470 Atlantic Ave., Boston, Mass. 02210, will publish the SRSS material.

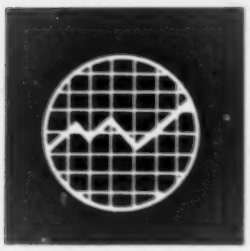
The following four episodes have been published: *Images of People; Leadership in American Society: A Case Study of Black Leadership; The Incidence and Effects of Poverty in the United States;* and *Testing for Truth: A Study of Hypothesis Evaluation.* Other episodes will be published during 1970 and 1971.

The first two paperback books, *Cities and City Life* and *Life in Families,* will be published in 1970. Others will follow at intervals.

A teacher training film, *Teaching Sociology: An Inquiry Approach,* has been produced in collaboration with the University of Michigan School of Education for showing at conferences and in workshops or institutes. It is available for rental or purchase from the University of Michigan Audio-Visual Education Center, 416 4th St., Ann Arbor, Mich. 48104.

A quarterly *Newsletter,* sent to all who request it, reports current developments in the project. Various aspects of the project and its product are discussed in the following: *Indiana Social Studies Quarterly* (whole issue), Winter 1967-68; William M. Hering, Jr., "Social Science, History, and Inductive Teaching," *Social Education,* January 1968; Thomas Switzer and Everett K. Wilson, "Nobody Knows the Trouble We've Seen: Launching a High School Sociology Course," *Phi Delta Kappan,* February 1969.

Further information is available from the project director.



I. TECHNOLOGY

59. ENGINEERING CONCEPTS CURRICULUM PROJECT (ECCP). **Edward E. David, Jr.**, Bell Telephone Laboratories, Inc., Murray Hill, N.J. 07974, and **John G. Truxal**, Polytechnic Institute of Brooklyn, 333 Jay St., Brooklyn, N.Y. 11201. (Grantee: Polytechnic Institute of Brooklyn.) (1967-) (Former grantee: Commission on Engineering Education, 1501 New Hampshire Ave., N.W., Washington, D.C. 20036.) (1964-1967)

At a conference held at Cambridge, Mass., in August 1964, it was decided that materials for a high school course in engineering concepts should be developed. Engineering concepts include those ideas that are basic to man-made devices, systems, processes, and structures. Preliminary reports were prepared outlining these concepts in greater detail. During July and August 1965, a further conference brought these materials to a state for trial at a few selected high schools in the New York area during the 1965-66 academic year.

The preliminary text is currently being published by the Webster Division of McGraw-Hill Book Company, Manchester Rd., Manchester, Mo. 63011, and is used (1969-70) in 200 secondary schools. Pilot programs are underway for use of the course in community colleges and liberal arts colleges.

The course, *The Man-Made World*, deals with the following: (1) Decisionmaking, Modeling, Optimization, and the use of Simulation, in order to better understand problems and final solutions to them. (2) Logic and Computers, concerning the extension of man's mental abilities through logic circuits and computers, as well as the processing of information. (3) Dynamic Systems dealing with stability, feedback, and amplification concepts as used in controlling systems. These systems might be the human body and social systems, as well as mechanical or electrical systems. Throughout the course man-machine and society-technology interactions are stressed. Many suggestions for activities beyond the text are in the fifty experiments included in the student laboratory manual, the teachers' manual, and a monthly newsletter. While there have been no films developed by the project, there are film notes on forty films which are available from commercial sources. The teachers' manual contains more than 150 master sheets from which transparencies can be produced by the teacher.

Representative newsletters, sample teachers' manual, and explanatory material on the course are available from E. J. Piel, Polytechnic Institute of Brooklyn, 333 Jay St., Brooklyn, N.Y. 11201.

IV. General Projects (K-12)

For additional projects related to this section see also:

8. Study of Mathematics Achievement in Grades K-3.

11. AAAS Commission on Science Education.

60. VIDEO TAPE PROJECT OF THE ASSOCIATED COLLEGES OF THE MIDWEST. **Helen D. Berwald**, Department of Education, Carleton College, Northfield, Minn. 55057. (1968-)

The project is preparing a series of video tapes for use in pre-service and in-service teacher education courses. To show the classroom "as it is" a concerted effort has been made to capture unrehearsed, spontaneous classroom activity of elementary and secondary classrooms in as natural a setting as possible. No special lighting or props are used, and cameras and microphones are operated by remote control from a van parked outside the school. Teachers are urged not to make special preparations for the taping sessions.

The tapes, which in most instances show the use of materials of various new curriculum projects, may be used for a variety of purposes. Printed supplementary materials contain suggestions for using the tapes. A video guide designates the location of specific activities on the tape and thus encourages the use of the tapes as "teach along" devices rather than as materials to be viewed from beginning to end without interruption. The tapes may also be used for interaction analysis purposes.

Two categories of tapes are available. Some tapes consist of longer sequences from classrooms of a particular grade level or classrooms using materials of a particular project, and should prove valuable in the study of general teaching methodology. A second group of tapes presents shorter sequences from several grade levels or curriculum projects and focuses on specific topics such as inquiry strategies or the use of discussion groups.

One hundred twenty-six tapes are presently available for use in the area of social studies. These tapes represent classes from grades K-12 and contain materials from a number of the newer social studies curriculum projects.

A substantial amount of taping has been done in foreign languages and mathematics. As editing on these tapes is completed, they will become available for distribution.

Extensive taping in the sciences was done during the 1969-70 school year, with materials from a number of

the newer secondary and elementary science projects included. It is expected that the first of these tapes will be available for distribution in 1970.

Tapes produced by the project are available for purposes of teacher education only. A $20 dubbing charge is made for each tape.

A catalogue is available from project headquarters, with supplements planned as additional tapes are available for distribution.

Further information is available from the project director.

61. "HORIZONS OF SCIENCE" FILMS. **John S. Hollister**, Educational Testing Service, Princeton, N.J. 08540. (1959-1960)

The "Horizons of Science" film program consists of ten 20-minute, 16 mm, sound-color films, designed to communicate the excitement of science and an understanding of the significance of a number of current scientific projects. In effect, the films allow an audience to take actual field trips with prominent scientists and to hear them explain their work and its importance. The films are:

Visual Perception, with psychologist Hadley Cantril; *The Worlds of Dr. Vishniac*, with microbiologist Roman Vishniac; *Exploring the Edge of Space*, with aeronautical engineer Otto C. Winzen; *"Thinking" Machines*, with Claude Shannon, Alex Bernstein, and Leon Harmon; *The Mathematician and the River*, with mathematician Eugene Isaacson; *New Lives for Old*, with anthropologist Margaret Mead; *Project "Mohole,"* films of the U.S. oceanographic expedition surveying possible drilling sites; *The Realm of the Galaxies*, with astronomer Allan R. Sandage; *The Flow of Life*, with Benjamin Zweifach and others; and *Neutrons and the Heart of Matter*, with the late Donald J. Hughes.

Films, study guides, and a general descriptive brochure are available from the project director.

62. TEACHING RESOURCES DEVELOPMENT PROGRAM IN THE GEOLOGICAL SCIENCES (Duluth Conference). **Robert L. Heller**, Department of Geology, University of Minnesota, Duluth, Minn. 55812. (Grantees: National Academy of Sciences–National Research Council, 2101 Constitution Ave., N.W., Washington, D.C. 20418; University of Minnesota, Minneapolis, Minn. 55455.) (1959-1960)

The Duluth Conference held in the summer of 1959 was the first project undertaken by the American Geological Institute in its effort to improve earth science teaching in secondary schools. At the conference 35 geologists and other earth scientists, secondary-school teachers, and science educators produced preliminary materials for a Geology and Earth Science Sourcebook for Elementary and Secondary Schools. Materials prepared at the conference were evaluated by scientists and teachers, revised and then published in 1962.

The primary objective of the American Geological Institute in producing the sourcebook was to bring together in one place up-to-date, well-organized subject matter that could be used by teachers with little or no training in the earth sciences. The sourcebook contains 18 chapters on the hydrosphere and lithosphere, one each on atmospheric science and astronomy, and three chapters designed to supplement high school biology, chemistry, and physics curriculum materials.

R. L. Heller (ed.), *Geology and Earth Science Sourcebook for Elementary and Secondary Schools*, Holt, Rinehart & Winston, Inc. This volume is out of print; a revised edition is in preparation.

Further information may be obtained from Holt, Rinehart & Winston, Inc., 383 Madison Ave., New York, N.Y. 10017.

63. IMPROVING THE DEVELOPMENT AND USE OF ACADEMICALLY-BASED SOCIAL SCIENCE CURRICULA, K-12. **Irving Morrissett**, Social Science Education Consortium, Inc., 970 Aurora, Boulder, Colo. 80302. (1967-)

The Social Science Education Consortium (SSEC) has had as its major purposes (1) encouraging social scientists to become more actively engaged in the development and implementation of curriculum materials for elementary and secondary schools, and (2) facilitating communication between and among the various federally and privately funded curriculum materials projects and the school communities they are intended to serve. Specific conferences, studies, and other activities have dealt with the relationship of learning theory to social science learning; values in the social sciences; structuring the social sciences for curriculum development; methodology of evaluation; in-service teacher education; training teacher-associates; retrieving social science literature; determining rationales for selection of social science content; development of a curriculum materials analysis system; working with school systems in the implementation of new social science curriculum materials; and publishing newsletters which report new trends on activities in social science education.

The SSEC has not developed classroom curriculum materials. Its publications include position papers, conference reports, research analyses, and analyses of curriculum materials packages.

A price list of publications and copies of the *Newsletter* are available on request. Further information may be obtained from the project director..

64. CONFERENCE ON SOCIAL SCIENCE IN THE SCHOOLS: A SEARCH FOR RATIONALE. **Irving Morrissett**, Social Science Education Consortium, Inc., 1424 15th St., Boulder, Colo. 80302. (1967-1968)

It was the purpose of this conference to establish communication among all of the groups involved in successful curriculum change in the social sciences. Outstanding educators and administrators gave presentations which served as the starting point for discussions on the question of the proper role of the social sciences and the social studies in elementary and secondary education. Fifty-five participants representing all of the social science groups involved in the processes of curriculum creation, dissemination, adoption, and adaptation attended the conference. A published volume of the proceedings will be available from the project director.

65. SCHOOL MATHEMATICS STUDY GROUP (SMSG). **E. G. Begle**, Cedar Hall, Stanford University, Stanford, Calif. 94305. (1961-) (Former grantee: Yale University, New Haven, Conn. 06520.) (1958-1961)

The primary purpose of the SMSG is to foster research and development in the teaching of school mathematics. So far, major objectives of the study group have been the preparation of sample text materials designed to illustrate the kind of curriculum which the members of the group feel is demanded by the increased use of science, technology, and mathematics in our society, and the preparation of materials designed to help teachers prepare themselves to teach such a curriculum. Currently, consideration is being given to the planning of an integrated, sequential mathematics curriculum for grades 7-12 which will take full advantage of the last ten years of mathematics curriculum development. Arrangements of topics will be chosen to maximize the efficiency of the program and thus permit inclusion of the equivalent of a full year of calculus and some of the basic notions of probability and numerical analysis. The relationships between mathematics and the sciences will play an integral part from the beginning. A second major activity of the SMSG is the contribution of the National Longitudinal Study of Mathematical Abilities in which students originally in grades 4, 7, and 10 are being followed to determine the effects of conventional, SMSG, and other new course sequences on performance in mathematics and science in school and college. In addition, SMSG carries out experimentation with various specialized materials designed to fulfill specific needs in mathematics education. Available materials include:

1. Elementary School Texts–The elementary school materials are designed for use in self-contained classrooms and are suitable for average students as well as for those of higher ability. For each of the grades 1 through 6, there is a student text and a teachers' commentary; for kindergarten, there is only a teachers' book.

2. Junior High School Texts–These texts review and extend the mathematics of the elementary school in such a way as to provide a sound intuitive foundation for high school courses. A considerable amount of informal geometry is included. Each text is accompanied by an extensive teachers' commentary.

3. Texts for Slower Students–These texts include the bulk of the mathematics for grades 7-9 listed in the series above and below, but with the level of reading difficulty reduced. It is expected that students will proceed through these materials at a slower rate. Each text is accompanied by an extensive teachers' commentary.

4. High School Texts–These texts are designed for average and above-average students in a college preparatory program.

5. Supplementary Materials–A variety of booklets is available. Their common characteristic is that each requires less than a full academic year. In addition to the revised version of *Mathematics Through Science*, the unit *Mathematics and Living Things* is available in preliminary form. It is designed for use at the eighth-grade level and uses biological experiments to motivate mathematical ideas.

6. Supplementary and Enrichment Series–Most of these pamphlets are designed to allow teachers to try short modern treatments of particular mathematics topics in class. Student text and teachers' commentaries are available for most of the topics, though some pamphlets are designed for independent study or enrichment.

7. New Mathematical Library–This consists of a series of short expository monographs on various mathematical subjects. The objectives of this series are the dissemination of good mathematics in the form of

elementary topics not usually covered in the school curriculum, the awakening of interest among gifted students, and the presentation of mathematics as a meaningful human activity.

8. Studies in Mathematics—All the books in this series are intended for teachers. Some provide the background for a specific student course, and others are more general in nature.

9. Study Guides in Mathematics—These consist of annotated bibliographies on various parts of mathematics, all bound in one pamphlet. They are intended for independent teacher study and for course planning for teachers. The newest in this series is a study guide on digital computing and related mathematics and consists essentially of an annotated bibliography intended for teachers interested in the topic of high-speed computation as it might appear in the high school program. Other study guides available are on algebra, calculus, geometry, number theory, and probability and statistics.

10. Filmed Course for Elementary School Teachers—This course consists of 30 half-hour color films. The series is intended primarily for in-service elementary school teachers and is intended to furnish a foundation in mathematics for any of the newer elementary school mathematics programs. *Brief Course in Mathematics for Elementary School Teachers* from the series *Studies in Mathematics* is designed to accompany the filmed course. The first 16 of these films provide a suitable background in mathematics for teachers of grades K-3. The remainder, building on these, is concerned with mathematics normally taught in grades 4-6.

In addition to the above, the study group has (1) arranged for translation of some publications into Spanish, (2) prepared programed learning materials in some areas, and (3) prepared numerous reports and supplementary publications. For information about the activities of the SMSG, a list of publications and films, or to receive the SMSG *Newsletter*, write the project director.

66. CAMBRIDGE CONFERENCE ON SCHOOL MATHEMATICS (CCSM). **Hugh P. Bradley**, Education Development Center, Inc., 55 Chapel St., Newton, Mass. 02160. (1963-1970)

The Cambridge Conference on School Mathematics (CCSM) is an association of prominent mathematicians who are actively involved in mathematics education from kindergarten through grade twelve. Since 1963, these mathematicians, under the auspices first of Educational Services Incorporated and later of Education Development Center, have organized three major conferences on mathematics and have carried on activities related to the findings of the conferences.

The first conference, which gave the program its title, was held in Cambridge, Mass., in the summer of 1963 to explore curriculum reform needs in mathematics "with a view to a long-range future." The deliberations of the participants, a group of twenty-five mathematicians and users of mathematics, were published in a report entitled *Goals for School Mathematics*. In this report the participants, free from the bonds of practical considerations that govern present-day curriculum reform, were able to outline their exploratory thinking for what, at that time, seemed the distant future.

The impact of the report on the mathematical world led to activity around the country in the preparation of classroom materials based on the ideas of the report, and to classroom experimentation with this material. The CCSM itself prepared materials and subsequently carried out classroom experiments.

The materials developed were not a curriculum but rather isolated units of mathematical education, which were used in the classroom to demonstrate that the suggestions in *Goals* were realistic. After very preliminary trials to test feasibility, the materials were made available to the mathematical and educational community for more widespread trial and more extensive use.

Forty-six Feasibility Studies have been prepared. Copies of these studies are available from ERIC Information Analysis Center for Science Education, 1460 West Lane Ave., Columbus, Ohio 43221.

The second major CCSM conference was held in the summer of 1966 to consider the problems of training mathematics teachers to meet the needs of the changed and changing mathematics curricula. The outcome of this conference was reported in *Goals for the Mathematical Education of Elementary School Teachers*. In this report the CCSM makes firm recommendations on content and pedagogy required in a good teacher-education program for mathematics. As a result of this conference, pilot experiments have been initiated at several large universities in the United States.

The growing concern about the gulf between school mathematics and school science was the reason for the third major CCSM conference, which took place in the summer of 1967. The participants in this conference, including many of the leaders of curriculum reform in mathematics and science, found considerable agree-

ment on the benefits that mathematics education can derive from properly directed scientific activity, and on the need for mathematics to support science education. Both traditional and newer curricula in mathematics and science were examined critically. Areas of possible cooperation were identified and areas of curriculum content of questionable value were subjected to thorough examination. The published report of this conference is *Goals for the Correlation of Elementary Science and Mathematics.*

All three conference reports may be obtained from Houghton Mifflin Co., 2 Park St., Boston, Mass. 02107.

67. CONFERENCE ON COMPUTER-ASSISTED INSTRUCTION. **Ralph T. Heimer**, Department of Education, Pennsylvania State University, University Park, Pa. 16802. (1968-1969)

This conference, sponsored jointly by the Pennsylvania State University and the Committee on Programmed Instruction of the National Council of Teachers of Mathematics, was designed to inform mathematics educators about the present status of computer-assisted instruction and its prospects for the next several years. The objectives were to explore CAI from several points of view: (1) hardware, including its flexibility, capacity, and reliability; (2) software, with the focus on quality and extent of available curriculum programs and magnitude of the task of preparing such programs; and (3) implementation, its feasibility, the impact on school organization, and economic and social implications. A printed report of the conference is available from the National Council of Teachers of Mathematics, 1201 16th St., N.W., Washington, D.C. 20036.

68. PLANNING SESSION ON THE DEVELOPMENT OF BEHAVIORAL SCIENCES AT THE PRE-COLLEGE LEVEL. **C. Alan Boneau**, American Psychological Association, 1200 17th St., N.W., Washington, D.C. 20036. (1967-1968)

This grant supported a meeting which discussed guidelines and recommendations for subsequent considerations of teaching the behavioral sciences at the pre-college level. This exploratory meeting involved ten persons representing the fields of psychology, sociology, anthropology, economics, and education in a three-day session. The participants considered the desirability of presenting behavioral science at the elementary as well as the secondary level, the quality of such instruction where it is now offered, the feasibility of unifying the several behavioral sciences in integrated curricula, the multiplicity of efforts needed, and the strategies to be followed in accomplishing the objectives.

Further information is available from the project director.

69. CONFERENCE ON INTERDISCIPLINARY SCIENCE EDUCATION. **Leo Schubert**, Department of Chemistry, American University, Washington, D.C. 20016. (1968)

This grant to the American University provided funds to support a four-day conference of scientists, mathematicians, and educators concerned with the problems of an interdisciplinary approach to secondary school science curricula. The conference was arranged to allow ample opportunity for round-table discussions as well as addresses by leaders in the move toward interdisciplinary curriculum development. Thirty-six conferees, including representatives of the major groups now developing interdisciplinary curricula attended the conference. Widespread publication of the outcomes of the confefence is planned.

Further information is available from the project director.

70. CONFERENCES ON SCIENCE CURRICULUM PLANNING. **Verne N. Rockcastle**, Science Education Division, Cornell University, Ithaca, N.Y. 14850. (1964-1965)

With Professor Jean Piaget (University of Geneva, Geneva, Switzerland) as leader, selected scientists, science educators, and psychologists met to share the latest research in cognitive learning in children, with emphasis on the implications of research on cognitive studies for curricular development in science at the elementary and junior high school levels. The conferences were held in the spring of 1964 at Cornell and at the University of California, Berkeley.

A final report, entitled *Piaget Rediscovered*, is available from the project director.

71. SEMINAR ON CHILDREN'S LEARNING. **Jerome S. Bruner**, Center for Cognitive Studies, Harvard University, Cambridge, Mass. 02138. (1963)

Following a planning conference, a two-week seminar in June 1963 brought together nearly 30 psycholo-

gists and a half dozen consultants from mathematics and the sciences to discuss the psychological processes involved in learning during the elementary school years. Working groups prepared papers on motivational problems in children's school learning, cognitive processes, and problems of stimulus presentation, with emphasis on such matters as sequence of presentation, reinforcement rate, etc. An editorial committee chaired by Dr. Bruner has prepared a report to the supporting agencies (National Science Foundation and U.S. Office of Education): J. Bruner (ed.), *Learning About Learning*, U.S. Government Printing Office (1966).

Further information is available from the project director.

72. STUDY ON FUNDAMENTAL PROCESSES IN EDUCATION. **R. M. Whaley**, University City Science Center, 3508 Market St., Philadelphia, Pa. 19104. (1959)

Some of the outcomes of this conference are recorded by J. S. Bruner in *The Process of Education*, Harvard University Press, Cambridge, Mass. 02138.

PROJECT ABBREVIATIONS—GRANTEE INSTITUTIONS

ACM	Associated Colleges of the Midwest Video Tape Project (Associated Colleges of the Midwest)
ACSP	Anthropology Curriculum Study Project (American Anthropological Association)
BICP	Biomedical Interdisciplinary Curriculum Project (University of California, Berkeley)
BSCS	Biological Sciences Curriculum Study (University of Colorado)
CBA	Chemical Bond Approach Project (Earlham)
CHEM Study	Chemical Education Material Study (University of California, Berkeley)
CSE	Commission on Science Education (American Association for the Advancement of Science)
ECCP	Engineering Concepts Curriculum Project (Polytechnic Institute of Brooklyn)
ESCP	Earth Science Curriculum Project (American Geological Institute)
ESS	Elementary Science Study (Education Development Center, Incorporated)
HSGP	High School Geography Project (Association of American Geographers)
IPS	Introductory Physical Science (Education Development Center, Incorporated)
ISCS	Intermediate Science Curriculum Study (Florida State)
MACS	*Man: A Course of Study* Course (Education Development Center, Incorporated)
MINNEMAST	Minnesota School Mathematics and Science Teaching Project (University of Minnesota)
PISP	Portland Interdisciplinary Science Project (Portland State)
PPC	Project Physics Course (Harvard)
PS II	Physical Science, 2nd Year Course (Education Development Center, Incorporated)
PSSC	Physical Science Study Committee (Education Development Center, Incorporated)
QAESS	Quantitative Approach in Elementary School Science (SUNY at Stony Brook)
SAPA	Science—A Process Approach (American Association for the Advancement of Science)
SCIS	Science Curriculum Improvement Study (University of California, Berkeley)
SMSG	School Mathematics Study Group (Stanford)

SRSS	Sociological Resources for the Social Studies (American Sociological Association)
SSCP	School Science Curriculum Project (University of Illinois)
SSCP	Social Studies Curriculum Program (Education Development Center, Incorporated)
SSEC	Social Science Education Consortium (Social Science Education Consortium)
SSMCIS	Secondary School Mathematics Curriculum Improvement Study (Teachers College, Columbia)
SSSP	Secondary School Science Project (Rutgers)
TSM	*Time, Space, and Matter* Course (Rutgers)
UICSM	University of Illinois Committee on School Mathematics (University of Illinois)
UMIST	Use of Mathematics in Science Teaching (University of Illinois)

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